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ANNUAL REPORT ON SILVICULTURAL RESEARCH

IN

THE MADRAS PRESIDENCY

FOR THE YEAR 1934-35

PART I—
- RESULTS.
- WORKING PLANS.
- STATISTICS.
- STAFF.

PART II—
- EXPERIMENTAL DATA.

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ERRATUM.

The Dipterocarpus seed obtained from Travancore and used in some of the experiments mentioned in this report has been definitely identified by Dehra Dun. Therefore wherever it occurs for *Dipterocarpus bourdillonii* please read *Dipterocarpus indicus*.

ANNUAL REPORT ON SILVICULTURAL RESEARCH IN THE MADRAS PRESIDENCY FOR THE YEAR 1934–35.

PART I.

I. RESULTS AND INDICATIONS.

(*i*) General.

1. As in previous years, a large amount of the work done this year has been small-scale (Stage 1 *a*) investigation in experimental gardens of which there are now 15. Inevitably a large amount of the work consisted in repetitions of previous experiments in order to confirm the results obtained from them and in routine seed germination and weighment tests. The new research centre at Emmanur, North Coimbatore Division, for investigating regeneration methods for dry fuel forests is now in full swing.

2. The most important results during the year are probably—

(1) The successful transmission of the spike disease of sandal by insects in the mass infection cages at Jowalagiri and Denkanikota.

(2) The success obtained by pre-monsoon stump planting of teak and other species in a year with an abnormally dry and prolonged hot weather.

(3) The demonstration of the retarding effect some ponam crops have on a teak plantation and how it can be minimized by early planting the teak.

(4) The successful storage of teak stumps and their transport to distant places.

(5) The confirmation of the fact that in our more important teak tracts soil aeration by forking gives no advantage over ordinary weeding methods.

(*ii*) Climates.

3. In an endeavour to give an idea of the climates in which the experiments have been done a rainfall statement for all research centres is given in paragraph 246. In this statement the rainfall figures are given in inches monthwar, and underneath this is given the number of rainy days in that month, e.g., $\frac{10\cdot71 \text{ (inches of rain in the month)}}{15 \text{ (rainy days in the month)}}$. In addition to this the last column of the table gives the average annual rainfall of the place over as long a period of years as is possible, together with the average number of rainy days per year where it is known. The period of rainfall given—1st April 1934 to 30th June 1935—covers all the 1934 experiments. The rainfall is totalled for the year 1st April 1934 to 1st April 1935 as this period covers most measurements and is to be compared with the average annual rainfall given in the last column.

(*iii*) Natural Regeneration by Seed.

4. *Hopea parviflora.*—Observations in Experimental plots 115—117, South Coimbatore, opened in 1931 in Karian shola to test the effect of shrub cutting and canopy manipulation on the development of unestablished regeneration of *Hopea parviflora* showed an average height increment of just over nine inches in the year.

Indications are (1) that the opening of the top canopy is having a beneficial effect. This is seen by the fact that in the canopy opened plot 90 per cent of the plants showed a height increment during the year while in the control plot only 50 per cent showed such an increment, (2) that the shrub cutting is causing a slight increase in the girth increment but exposing the plants to browsing.

5. An experiment in South Coimbatore Division (Experimental plot 132) showed indications that clearing undergrowth and raking the soil under mother trees was harmful and decreased the incidence of natural regeneration. These indications could not be confirmed or otherwise as none of the mother trees in the plot flowered or fruited this year.

6. *Mesua ferrea.*—Plots similar to those for *Hopea parviflora* established in 1932 to test the effect of shrub cutting and canopy manipulation (Experimental plots 122, 123, South Coimbatore Division and Experimental plots 3, 4, 5 and 6 of Wynaad Division) again showed negligible growth during the year. Removal of undergrowth and the opening of the canopy have not produced any significant effects during the first two years.

It is probable that this natural regeneration of evergreen species which has long been suppressed will not respond to silvicultural treatment for several years.

7. *Artocarpus hirsuta.*—Continued observation of an experiment done by the District Forest Officer, South Mangalore Division (Experimental plot No. 1, South Mangalore Division), still indicates that burning the leaf litter under *Artocarpus hirsuta* seed bearers results in an increased incidence of seedling regeneration.

8. *Swietenia macrophylla.*—An experiment on the growth and survivals of young natural regeneration of *Swietenia macrophylla* under mother trees (Experimental plot 127, Nilambur) in which seedlings were selected in two groups under shade and in the open in a randomized way, 100 seedlings in each class showed that although the two sets of seedlings were initially comparable in mean height, after one year those growing in the open were significantly better. Casualties during the year were negligible. Observation of the experiment will be continued to confirm this indication that natural regeneration of mahogany 5 feet to 6 feet in height needs full light for its development.

9. Experimental plot 125 at Nilambur is an experiment started in 1933 to ascertain whether clearing dense undergrowth under mahogany trees where natural regeneration is scanty will induce

abundant regeneration. When the plot was opened all natural regeneration existing was pulled up and counted. 1933 was a very poor seed year and very little regeneration resulted. 1934 which was a fairly good seed year resulted in almost exactly the same number of new seedlings as were pulled up originally. Thus clearing the undergrowth does not appear to induce regeneration.

10. *Natural regeneration by coppice.*—As noted in the last year's Annual Report, paragraph 7, Chittoor Division Experimental plots 1–9 and South Coimbatore Division Experimental plot No. 131 which were intended to test the effect of (*a*) high and low cutting and (*b*) trimming and not trimming the stools were given up as unsuitable owing to the large variety of species and sizes of stumps dealt with and to the experimental method being unsuitable.

11. A new plot (Chittoor Division Experimental plot No. 11) has been formed in coupe VI, Gadanki Fuel Series, which deals with a sufficiently large number of trees of a restricted number of species, treatments have been applied and results are awaited.

These results will confirm (or otherwise) the indications already obtained that the effect of trimming (if any) is so slight, that the extra cost and trouble of such trimming of stumps is not justified.

(*iv*) SEEDS.

Seed pre-treatment.

12. Routine pre-treatment tests were made with 19 species the treatments used being cold, hot, and boiling water, with an untreated control in each case. Seed purity per cent and seed weights were also recorded.

The germinative capacity of seed of the following species was not apparently improved by any of the treatments used :—

Acacia ferruginea.
,, *leucophlœa.*
,, *sundra.*
Acrocarpus fraxinifolius.
Albizzia amara.
Anacardium occidentale.
Cassia fistula.
Cassia marginata.
Cassia siamae.
Chloroxylon swietenia.
Dalbergia latifolia.
Dalbergia sissoides.
Dendrocalamus strictus.
Gmelina arborea.
Lagerstrœmia lanceolata.
Prosopis juliflora.
Pterocarpus dalbergioides.
Pterocarpus marsupium.
Tectona grandis.
Terminalia crenulata.
Terminalia paniculata.

13. Treatment with boiling water (water 20 times the volume of the seed used is brought to the boil, taken off the fire and the seed immediately put in and left till cold) appears to increase the germination of *Acacia auriculiformis* and *Acacia cyanophylla* (very marked).

Treatment with hot water as hot as the hand can bear definitely improved the germinative capacity of *Pithecolobium dulce* and *Terminalia chebula*, the latter being very marked.

Soaking in cold water for 24 hours was beneficial in the cases of *Calophyllum elatum, Gluta travancorica, Pterocarpus santalinus* and *Xylia xylocarpa*. In this report it is again brought to notice that pre-treatment of teak seed by soaking in cold water neither increases nor accelerates its germination.

14. The results of pre-treatment tests are summarized in the table below. Generally 100 seeds for each treatment were used in each test though in a few cases 200 seeds or 50 seeds were used. Previous years' tests are included.

Species.	Number of tests made.	Average germinative capacity with				Remarks.
		Un-treated.	Cold water.	Hot water.	Boiling water.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Acacia auriculiformis.	5	15	16	22	26	Boiling water best in 4 out of 5 tests.
Acacia cyanophylla.	9	11	14	17	35	Boiling water best in 8 out of 9 tests.
Acacia ferruginea ..	5	64	57	62	60	
Acacia leucophlœa ..	4	23	14	21	16	
Acacia sundra ..	10	34	28	30	25	
Acrocarpus fraxinifolius.	25	8	8	9	6	
Albizzia amara ..	12	42	41	45	36	
Anacardium occidentale.	6	70	58	54	24	Untreated consistently best.
Calophyllum elatum.	1	3	8	6	0	
Cassia fistula ..	7	17	17	14	9	
Cassia marginata ..	6	26	29	23	8	
Cassia siamea ..	7	59	60	53	53	
Chloroxylon swietenia.	5	26	27	21	1	
Dalbergia latifolia ..	21	31	25	29	6	
Dalbergia sissoides ..	30	26	26	32	5	
Dendrocalamus strictus.	5	33	22	22	0	
Gluta travancorica ..	5	11	15	10	6	
Gmelina arborea ..	25	20	19	18	6	
Lagerstrœmia lanceolata.	30	5	4	4	0	
Pithecolobium dulce.	2	36	29	44	0	
Prosopis juliflora ..	5	71	72	61	54	
Pterocarpus dalbergioides.	1	23	21	22	8	
Pterocarpus marsupium.	50	39	32	34	14	
Pterocarpus santalinus.	6	8	54	12	1	
Pterocarpus santalinus (seed coat removed).	1	24	40	33	10	
Tectona grandis ..	40	28	27	24	8	
Terminalia chebula—						
(1) whole fruit ..	4	26	27	42	2	
(2) (fleshy covering removed).	3	4	6	5	7	
(3) kernel ..	4	6	1	2	0	Damaged by white ants.
Terminalia crenulata—						
(1) Fresh seed ..	47	32	36	32	6	
(2) Stored, 14 months.	10	9	8	7	8	
Terminalia paniculata.	10	13	8	10	0	
Xylia xylocarpa ..	42	20	26	25	13	

15. Soaking in lime water for 24 hours soaking in water for 48 hours and then keeping moist in straw out of free air circulation, scorching over a fire, and soaking in concentrated sulphuric acid for 15 minutes gave the following results :—

	Number of tests.	Not pre-treated.	Lime water.	Soaking in water and keeping moist.	Scorching.	Sulphuric acid.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Acacia leucophloea.	10	10	*	25	10	17
Cassia fistula ..	11	13	9	2	..	† 35
Cassia marginata.	11	22	13	10	..	† 36
Pterocarpus santalinus.	10	30	*	8	2	8
Terminalia chebula.	11	27	18	73	32	1

(Each test is of 100 seeds.)

* Not tried.
† Seed treated with sulphuric acid germinated nearly twice as quickly as untreated seed.

Concentrated sulphuric acid hastened and also greatly improved the germination of *Cassia fistula* and *Cassia marginata* while soaking in water and then keeping moist in straw out of free air circulation improved the germination of *Acacia leucophlœa* and greatly improved that of *Terminalia chebula.*

Seed—seasonal collection within the fruiting season.

16. *Teak.*—Three tests at three centres done with teak seed collected from plantation and natural forest trees at weekly intervals in the fruiting season from 7th January 1934 to 20th February 1934, showed practically no variation in germinative capacity throughout the period for either type of mother tree. Each test for each date consisted of 10 sets of 100 seeds. These tests therefore covered 48,000 seeds.

17. *Terminalia crenulata.*—Two sets of similar tests at two centres with this species gave the same result, i.e., no variation in germination per cent throughout the fruiting season.

18. *Terminalia chebula.*—Many districts have experienced difficulty in germinating *Terminalia chebula* and it was thought that seed when apparently ripe on the trees was in reality unripe. To test this a seed collection was made every fifteen days during the fruiting period and gave the following results :—

Species.	Germinative capacity of seed collected on 4th February 1934.	19th February 1934.	5th March 1934.	20th March 1934.
(1)	(2)	(3)	(4)	(5)
Terminalia chebula	48	42	58	41

(600 seed in each test.)

The seed thus showed very little variation in germinative capacity, throughout the fruiting season.

19. The above type of test was further extended to endeavour to find out how long seed would lie on the ground without losing its germinative capacity. Seeds of five species were sown in Emmanur nursery in six sub-beds for each species. Watering to induce germination was started in the different treatments after intervals of one week.

Results indicate that *Acacia ferruginea*, *Acacia leucophlœa* and *Acacia sundra* still retained their original germinative capacity after lying on the ground for six weeks. *Albizzia amara* lost 60 per cent of its original germinative capacity after one week on the ground and *Cassia siamea* lost 50 per cent after three weeks.

20. *Seed storage.*—Tests made at intervals with seed from the same sample gave the following indications of the length of time the seed remains fertile (previous years' results are included):—

Species. (1)	Method of storage. (3)	Number of individual tests. (3)	Number of series of the same sample of seed. (4)	Remarks. (5)
Acacia auriculiformis.	(1) Stoppered bottle.	21	7	Number falling off up to 5 months.
	(2) Earthen pot.	21	7	
	(3) Gunny bag ..	21	7	
	(4) Air-tight tins.	24	4	Number falling off up to 8 months.
Acacia cyanophylla.	(1) Stoppered bottle.	21	6	Number falling off up to 8 months.
	(2) Earthen pot.	21	6	
	(3) Gunny bag ..	21	6	
	(4) Air-tight tins.	28	8	Seed 10 months old only slightly less fertile than fresh seed.
Acacia ferruginea.	(1) Stoppered bottle.	21	7	Seed perfectly good after 8 months.
	(2) Earthen pot.	21	7	
	(3) Gunny bag ..	21	7	
	(4) Air-tight tins.	20	4	
Acacia leucophlœa.	Air-tight tins.	8	4	Seed good after 6 months.
Acacia sundra ..	(1) Stopperedbottle.	18	6	Seed good after 7 months.
	(2) Earthen pot.	18	6	
	(3) Gunny bag ..	18	6	
	(4) Mud pot with wood ash.	37	7	Seed good after 8 months falling off slightly by 12 months.
Acrocarpus fraxinifolius.	(1) Gunny bags	90	25	Seed after 15 months as good as fresh seed.
	(2) Air-tight tins.	20	4	
Albizzia amara ..	Mud pot with wood ash.	32	8	Seed good after 19 months.
Anacardium occidentale.	Gunny bags ..	20	4	As good as fresh up to 5 months; deteriorates to 50 per cent by 9 months.
Cassia fistula ..	Air-tight tins ..	20	8	Gradual falling off after 2 months.
Cassia marginata.	Do. ..	16	8	Seed good after 8 months.
Cassia siamea ..	Mud pots with wood ash.	20	4	Seed good after 18 months.
Cedrela toona ..	Gunny bags ..	11	1	Definite falling off from 70 per cent at 4 weeks to 26 per cent at 6 weeks to 0 at 9 weeks in the only test done.
Chloroxylon swietenia.	Air-tight tins ..	26	8	Seed good up to 6 weeks and rapidly deteriorates.
	Gunny bags ..	8	1	Seed good up to 3 months.
Dalbergia latifolia.	Gunny bags (pods).	106	18	Seed good up to 6 months.
	Air-tight tins ..	24	12	Seed good up to 3 months. Results very variable and no seed has given any results after one year.
Gluta travancorica.	Gunny bags ..	36	6	Seed good up to 3 months.
Gmelina arborea ..	Gunny bags ..	75	15	Variable. Seed usually good up to 6 or 8 weeks.
Hopea parviflora ..	Gunny bags ..	33	2	Seed good after 20 days falling to 0 after 40 days.
Lagerstrœmia lanceolata.	Gunny bags ..	24	6	Seed good up to 4 months.
	Air-tight tins ..	24	6	Seed good up to 6 months.
Palaquium ellipticam.	Gunny bags ..	16	2	Variable usually good up to about 2 months.
Prosophis juliflora.	(1) Stoppered bottle.	18	6	Seed good after 7 months.
	(2) Earthen pot.	18	6	
	(3) Gunny bag ..	18	6	
	(4) Air-tight tins.	20	4	
Pterocarpus marsupium.	(1) Gunny bags	120	18	Variable, usually good up to 5 months.
	(2) Air-tight tins.	30	12	
Pterocarpus santalinus.	(1) Gunny bags.	27	4	Good up to 5 months; indications are that it is good up to 8 months.
	(2) Earthen pot.	18	6	
	(3) Stoppered bottle.	18	6	

Species.	Method of storage.	Number of individual tests.	Number of series of the same sample of seed.	Remarks.
(1)	(2)	(3)	(4)	(5)
Santalum album.	Air-tight tins ..	10	2	Good up to 8½ months.
Swietenia macrophylla.	Gunny bags ..	10	1	Seed good up to 2 months falling to 0 at 3 months.
Tectona grandis ..	Gunny bags ..	150	22	Seed good up to 8 months, falls to about 50 per cent after 15 months. It keeps much better in gunny bags than air-tight tins.
	Air-tight tins ..	40	8	
Terminalia chebula.	Gunny bags ..	36	6	Seed good up to 8 months, falling to about 50 per cent after 12 months.
	Stoppered bottle.	12	6	
	Earthen pot ..	12	6	
Terminalia crenulata (tomentosa).	Gunny bags ..	150	22	Seed good up to 5 months, deteriorates to 50 per cent by 9 months. Still gives about 10 per cent after 15 months. Keeps best in air-tight tins.
	Stoppered bottle.	35	6	
	Air-tight tins ..	20	4	
Terminalia paniculata.	Gunny bags ..	30	7	Seed good up to 5 months.
	Stoppered bottle.	30	7	
	Air-tight tins ..	30	7	
Xylia xylocarpa ..	Gunny bags ..	136	18	Very variable usually good up to 4 months.
	Stoppered bottle.	16	10	
	Air-tight tins ..	16	10	

NOTES.—(i) The above results are indications of probable longevity of the seed of the various species. Many more tests are necessary before reliable results can be obtained.

(ii) The periods in column (5) are the times between collection and sowing and *not* between collection and germination which is much longer.

(iii) Generally 100 seeds were used for each test.

(iv) In many cases the remark is given as "Seed good up to X months." Generally this is the maximum period tested and not the maximum period the seed remains fertile.

Seed of *santalum album* from which the pulp had been removed before sowing gave consistently better results than seed with the pulp left on. In 20 tests of each the average germinative capacities were with pulp 8·9 per cent and without pulp 30·8 per cent. The pulp should therefore always be removed from sandal seed before sowing.

Seed weighments.

21. Routine seed weighments were carried out. The results are given in paragraph 247 below in the form given in the "Note on weight of seeds (Revised)" by S. H. Howard and H. G. Champion (Forest Bulletin No. 41—1928).

Sorting seed according to size.

22. *Teak.*—Last year's experiments were repeated both for germination and planting out tests and results are confirmed.

Seed was selected as follows—(*a*) district random sample, (*b*) selected biggest seed, (*c*) selected medium seed and (*d*) selected smallest seed.

Results were as follows :—

Centre.	Year.	Average germination percentage of 1,000 seeds in ten sets of 100. District sample. PER CENT.	Selected biggest. PER CENT.	Selected medium. PER CENT.	Selected smallest. PER CENT.
Dhoni	1934	37	37	48	36
Anaipady	1934	52	64	56	40
Begur	1934	43	47	42	14
Average of 1934 experiments ..		44	49	49	30
Average of 1933 experiments ..		41	36	..	24

23. Planting out tests in three centres showed no appreciable difference in survival per cent or significant differences in mean height growth after one season.

Thus the sorting out and rejection of teak seed on account of size appears to be an unjustified expense.

(For full experimental data, see paragraph 248.)

Size, age and condition of seed-bearers.

24. *Teak.*—Seed was collected separately from large overmature trees (10′–13′ girth), middle sized trees approaching maturity ($4\frac{1}{2}'$ to 6′ girth) and small immature trees (below $3\frac{1}{2}'$ girth). Germination tests with the seed were inconclusive but indicated a slight inferiority of the seed from small trees.

Results of planting out tests were also inconclusive. In three experiments at three centres the seedlings from immature trees were slightly smaller than those of the other two kinds but in only one case was this difference significant.

We still have insufficient evidence to be definite but the indications are very strong that seed from both immature and overmature teak trees is just as good as that from normal trees provided of course that the tree is old enough to produce fertile seed.

(For experimental data, see paragraph 249.)

25. *Dalbergia latifolia.*—Three similar experiments with *Dalbergia latifolia* also gave inconclusive results. In planting out experiments no significant differences were obtained between plants from any of the three types of mother trees.

(For experimental data, see paragraph 250.)

26. *Terminalia crenulata.*—Three repetitions with this species gave similarly inconclusive results.

(For experimental data, see paragraph 251.)

Seed origin.

27. *All-India teak seed origin plots.*—During the year two new long term plots have been established. Experimental plot 129, Nilambur, is the most successful so far and six origins (Nilambur, Anamalais, Travancore, South Bombay, South Burma and North

Burma) have been established and were all 100 per cent in February 1935. The area consists of 10·2 acres in 24 randomised plots each plot containing approximately 520 plants, four plots to each origin.

28. Experimental plot 138, South Coimbatore Division, was not so successful and four origins were raised which showed a survival percentage in February 1935 of South Burma 83, Anamalai (Mount Stuart) 92, Mysore 94 and Nilambur 89 per cent. All casualties have been replaced and the area should be nearly fully stocked next year.

29. Existing plots were measured (Experimental plots 107, 123 and 129, Nilambur) and show the following order of origins with percentages of the best origins given for mean height growth :—

Experimental plot 107 (4 years old).		Experimental plot 123 (2 years old).		Experimental plot 129 (1 year old).	
1 Nilambur	100	Nilambur	100	South Bombay	100
2 South Bombay ..	94	Anamalai	96	Anamalai	93
3 Travancore	90	South Bombay	95	Travancore	81
4 North Burma ..	86	Travancore	92	Nilambur	81
5 Walayar	79	South Burma	81	South Burma	79
6 South Burma ..	70	North Burma	78	North Burma	65

It is proposed to close Experimental plot 107 which is open to slight objection on the grounds of insufficiently randomised lay out and the other three plots will be remeasured each year until the time comes for first thinning and then sample plots will be laid out in them.

30. Periodical measurements of selected plants in each origin were measured weekly.

(For periodic measurements results, see paragraph 218.)

31. Botanical differences in the appearance of plants of different origins were recorded. Leaf measurements showed that North Burma plants have the broadest leaves while Travancore and South Bombay have the narrowest ones. Leaf colours differed in the young leaves being purple in Nilambur plants, a purple brown colour in Travancore and Anamalai plants and a definite brown in the Burma and Bombay origins.

In leaf roughness, the upper surfaces of the leaves of Bombay and both Burma origins were much rougher than the South India origins. Experimental Plot 129, Nilambur, suffered damage from grass hoppers and monkeys.

(For full experimental data, see paragraph 252.)

(v) Nursery Work.

Effect of shade on germination survival and growth in nursery beds.

32. Last year's experiment done at Chittoor experimental garden was repeated this year at Emmanur experimental garden (North Coimbatore Division). All the species tried showed better germinative capacity in shaded beds except *Terminalia chebula* which showed a decided preference for the open and *Prosopis*

juliflora and *Pterocarpus santalinus* which were apparently indifferent. This to a large extent confirms last year's results (vide Annual Report 1933–34, paragraph 28).

33. As regards seedling survival and development all species preferred shade except *Terminalia chebula* which showed a decided preference for the open, *Acacia leucophlœa, Prosopis juliflora* and *Pterocarpus santalinus* which appeared indifferent and *Santalum album* which had faded away by the following June.

34. It may be noted in this connexion that although Emmanur has a hot dry climate it is not so rigorous as Chittoor but at the same time the hot weather of 1933 was not as severe as that of 1934 so that conditions in these two tests are very similar.

(For full experimental data, see paragraph 253.)

Effect of shade on germination.

35. *Teak.*—Two experiments each of 500 seeds per treatment (each test being five sets of 100) were done to see whether the germination per cent of teak was affected by shade. In both experiments no appreciable difference was found between the two treatments.

Nursery methods for raising Teak stumps.

36. Last year's experiments were repeated at Anaipady and Dhoni. The quantities of seed used and the outturn and size of stumps produced by each method were as follows :—

Data for a standard bed 40′ × 4′.

Nursery method.	Experiment number.	Quantity of seed used in pounds.	Number of usable stumps over 0·3 inches diameter produced.	Average diameter of stumps in inches.
A. Dense sowing	Dhoni No. 58 ..	80	969	0·35
	Anaipady No. 69 ..	96	1,395	0·38
B. Transplanting small seedlings 4″ × 4″.	Dhoni No. 58 ..	30	1,086	0·39
	Anaipady No. 69 ..	30	513	0·45
C. Germinating seed notched 4″ × 4″.	Dhoni No. 58 ..	14	1,232	0·38
	Anaipady No. 69 ..	20	737	0·46
D. Sowing soaked seed 3″ × 1½″ ..	Dhoni No. 58 ..	15	1,197	0·40
	Anaipady No. 69 ..	12	519	0·43

37. These results averaged for each treatment and compared with last year's results are—

Nursery method.	1934 sowing. Usable stumps.	1934 sowing. Average diameter of stumps.	1933 sowing. Usable stumps.	1933 sowing. Average diameter of stumps.
A	1,182	0·37	1,681	0·44
B	800	0·42	497	0·52
C	985	0·42	404	0·60
D	858	0·42	261	0·57

38. The indications are that though method A is the most wasteful in seed, the number of utilizable stumps produced per bed is much greater than in any other method. There are usually, moreover, a number of small stumps left over which will grow up into usable stumps in the second year without further attention or cost. A proportion of the seed also lies dormant in the beds

and germinates in the following year. The quantities of seed used in B and C are not very reliable but by both these methods fairly well-stocked beds can be obtained. In method D the stocking in the beds is likely to be poor, and a good deal of space is wasted, but the greatest economy of seed is obtained. In B, C and D there is little difference in the average size of stumps produced, but they are larger than those produced by method A. No stumps are left over for the second year.

39. In deciding which method should be adopted in practice, it is necessary to consider the relative cost of seed and of nursery bed space. It is probable that a compromise between method A and method D depending upon the quantity and cost of seed available is likely to be the best.

40. Planting out experiments with stumps raised by these four different methods gave no reliable indications that the stumps from one method were either better or worse than any other.

(For full experimental data of planting out experiments, see paragraph 254.)

Effect of sowing distance and covering with Phyllanthus twigs and straw on germination per cent.

41. *Teak.*—Two experiments were done at two centres in which four treatments were applied. Seeds were sown touching and 1 inch apart and of these two treatments half of each was covered with *Phyllanthus* twigs and straw and half left uncovered. Each treatment consisted of two sets of 100 seeds. The tests, therefore, covered 1,600 seeds. Results show that the effect of spacing the seeds was nil but that the uncovered seeds produced a slightly better germination than the covered seeds.

Actual results are :—

Experimental garden.	Germination per cent of — Uncovered — Seed touching.	Seeds 1″ apart.	Covered. — Seed touching.	Seeds 1″ apart.
Dhoni	51	48	37	28
Anaipady	28	32	31	36
Average ..	40	40	34	32

The experiment needs repetition.

(*vi*) ARTIFICIAL REGENERATION.

(*a*) *Mixed deciduous timber forests.*

42. *Effect of intensity of burning before regenerating gaps in mixed deciduous forests.*—Experimental plot No. 15, Wynaad Division, in which three treatments were applied to gaps in mixed deciduous forest (see last year's Administration Report, paragraph No. 35) was remeasured. The mean height growth of the teak in gaps which had a burn is still significantly better than that of gaps which were

not burned. The gaps with a light burn have done much better than those with a severe burn. Results are most easily seen from the following table :—

Increase in mean height growth over unburned gaps.

	First year.	Second year.
	PER CENT.	PER CENT.
Light burn	16	50
Severe burn	14	30

It is therefore, seen that burning of gaps in mixed deciduous forest before artificial regeneration is very beneficial and that the best results are obtained with a light burn.

(For full experimental data, see paragraph 255.)

43. *Comparison of direct sowing, entire transplanting and stump planting—Teak.*—Three experiments in three localities convincingly confirmed previous year's results that of these three methods of artificial regeneration for teak stump planting is the best. Direct sowing was a very poor second.

The results after one season of the three experiments averaged are :—

Percentage of survivals.			Mean height growth in inches.		
Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.
58	58	89	6·84	6·21	15·63

(For full experimental data, see paragraph 256.)

44. *Dalbergia latifolia.*—Similar experiments in three different localities again confirmed previous year's results that for *Dalbergia latifolia* stump planting is the best method with direct sowing a poor second.

The results of the three experiments after one season's growth averaged are :—

Percentage of survivals.			Mean height in inches.		
Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.
69	33	81	8·67	6·15	15·02

(For full experimental data, see paragraph 257.)

45. *Pterocarpus marsupium.*—Experiments in three localities gave the same result as for *Dalbergia latifolia* confirming previous year's results, stumping being best, direct sowing second and entire transplanting the worst.

The results of the three experiments after one season's growth averaged are—

Survival per cent.			Mean height in inches.		
Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.
68	82	90	10·13	7·25	16·15

(For full experimental data, see paragraph 258.)

46. *Terminalia crenulata*.—In three experiments in three different localities stump planting was easily the best method of regenerating this species artificially. With regard to sowing and transplanting the former method gave a better height growth while the latter gave a better survival per cent.

The averaged results of these three experiments after one season's growth are :—

Percentage of survivals.			Mean height in growth in inches.		
Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.
36	56	86	16·38	12·99	27·66

(For full experimental data, see paragraph 259.)

47. *Xylia xylocarpa*.—Results at three centres confirmed previous year's results that for *Xylia xylocarpa* direct sowing is the best method of raising the species. Transplanting gave much poorer survival percentage than stump planting but the latter gave slightly poorer height growth.

Results of these three experiments averaged after one season's growth are :—

Percentage of survivals.			Mean height in inches.		
Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.
72	16	53	6·61	4·19	4·08

(For full experimental data, see paragraph 260.)

48. *Swietenia macrophylla*.—Two experiments were done with Mahogany at Begur and Kannoth and the results show that from the consideration of both survival per cent and mean height growth transplanting is the best method of raising this species artificially. Mahogany definitely does not stump well and the method is unsuitable.

Averaged results of these two experiments after one season's growth are :—

Percentage of survivals.			Mean height growth in inches.		
Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.
38	63	8	11·10	11·90	5·52

(For full experimental data, see paragraph 261.)

49. *Artocarpus hirsuta*.—Only one experiment was done with this species in mixed deciduous forest and this indicates that although survivals were low and differences in height growth were not significant yet from both these points of view stump planting is the best method for this species and sowing comes second of the three methods.

Abbreviated results are—

Percentage of survivals.			Mean height growth in inches.		
Sowing.	Transplanting.	Stumping.	Sowing.	Transplanting.	Stumping.
12	2	33	11·16	12·00	14·88

(For full experimental data, see paragraph 262.)

50. *Pre-monsoon stump planting—General.*—The hot weather of 1934 was abnormally prolonged and early showers failed almost completely. In consequence the year was an indication of the risks likely to be run in pre-monsoon stump planting, and the experiments on this subject were watched with interest (and not a little anxiety !). In general the results after one season have substantially confirmed the results of previous investigations. Pre-monsoon stump planting has succeeded even in abnormally difficult weather conditions as is shown by the following table :—

Species.	Date of stump planting.	February 1935. Average survival.	Average mean height in inches.	Remarks.
		PER CENT.		
Teak	15th April 1934.	88	18·6	Average results of 5 experiments in 5 centres.
Dalbergia latifolia	16th April 1934.	71	23·6	Average results of 3 experiments in 3 centres.
Pterocarpus marsupium ..	16th April 1934.	82	29·7	Do.
Xylia xylocarpa	16th April 1934.	47	5·2	Average results of 2 experiments in 2 centres.

51. The success of pre-monsoon stump planting species other than teak in such a bad year is very striking as is seen from the mean height growth.

(For weather conditions, see rainfall statement, paragraph 246.)

It should be noted that the experiments at Kannoth were all done in a ponam crop of hill paddy.

52. *Teak.*—Five experiments were done at five centres.

Abbreviated experimental data are as follows :—

Teak—Percentage of survivals after one season.

Experimental garden.	Experiment number.	Year of formation.	Percentage of survivals of stumps planted on 15th March. 1934.	1st April 1934.	15th April 1934.	1st May 1934.	15th May 1934.	1st June 1934.	16th June 1934.
Topslip ..	45	1934	71	97	96	95	89	96	..
Begur ..	22 B	1934	12	22	92	..	..	..	..
Dhoni ..	42	1934	10	54	97	90	93	95	..
Walayar ..	1	1934	..	83	80	86	95	94	..
Kannoth * ..	1 A	1934	..	37	75	87	93	88	88

* In Ponam crop of hill paddy.

Height growth after one season.

Experimental garden.	Experiment number.	Year of formation.	15th March. 1934.	1st April 1934.	15th April 1934.	1st May 1934.	15th May 1934.	1st June 1934.	16th June 1934.
Topslip ..	45	1934	34·3″	29·5″	36·6″	30·0″	18·6″	18·5″	..
Begur ..	22 B	1934	10·2″	11·0″	11·6″	..	..	..	..
Dhoni ..	42	1934	15·0″	18·8″	17·8″	9·3″	11·3″	10·6″	..
Walayar ..	1	1934	..	16·6″	13·3″	16·1″	11·9″	11·2″	..
Kannoth* ..	1 A	1934	..	11·9″	13·7″	11·4″	10·9″	6·5″	5·3″

* In ponam crop of hill paddy.

53. It is seen that the best date of planting was April 15th which gave an average survival percentage of 88 and an average mean height growth of 18·6″ after the first season (February 1935).

Results of previous years are recapitulated—

Year.	Number of experiments.	Best date.	Percentage of survivals.	Mean height growth in inches.	Proportion of height growth of best date to 1st June planting.	Rains.
1932	3	16th April.	100	43·3″	2·0	Normal.
1933	3	1st April.	91	35·3″	2·4	Do.
1934	5	16th April.	88	18·6″	1·6	Abnormally dry.

54. Height growth in such a dry year was of course much smaller than in normal years but even so planting on 16th April gave a height growth 1·6 times that of normal 1st June planting.

The stumps sprouted much later than usual and most of it took place in June and July after the stumps had lain dormant in the soil for two to three months and yet increased height growth was obtained from them compared with stumps prepared and planted fresh on 1st June.

Sprouting of stumps planted on 16th April 1934 took place as follows :—

Date of observation.	Percentage sprouted in experiments at					Average.
	Dhoni.	Begur.	Topslip.	Kannoth.	Walayar.	
25th April 1935.	11	..	..	..	18	15
1st May 1935.	34	..	45	..	..	40
17th May 1935.	45	44	57	..	21	42
2nd June 1935.	48	65	62	51	22	56
26th June 1935.	71	83	88	65	27	77
16th July 1935.	93	88	88	75	78	84
Final survival ..	97	92	97	75	80	88

55. The experiments have been repeated in 1935 which has been another abnormally dry hot weather with a lack of early showers and results will be watched with interest.

56. The conclusions to be drawn from the above experiments are therefore that—

(1) even in unusually dry hot seasons stump planting as early as the middle of April gives sufficiently good stocking (88 per cent in a bad year) and an immense gain in height growth as compared with monsoon planting at the end of May or early in June (60 per cent in a bad year) ;

(2) success is not dependant upon what is generally considered good planting weather ;

(3) the immense advantage of the increased height growth of the teak in its struggle with weeds or field crops more than outweighs any risk of bad stocking and this risk can be insured against cheaply by providing a reserve of plants for normal monsoon stumping if necessity arises.

1934 experiments show that this risk is small.

For full experimental data see paragraph 263.

57. *Stump planting—Teak—Best date—Kurnool West Division.*—In an experiment done by the District Forest Officer, Kurnool West Division, teak stumps were planted fortnightly from 9th April to 27th June and indications are that the second half of June

is possibly the most suitable date for the district. The experiment however needs repetition with an extended set of dates from April to August or even longer.

Abbreviated results are—

Date of stump planting.	9th April 1934.	25th April 1934.	9th May 1934.	26th May 1934.	11th June 1934.	27th Jun 1934.
Percentage of survivals after one season.	0	3	6	0	93	97

58. Premonsoon stump planting of *Dalbergia latifolia*, *Pterocarpus marsupium*, *Xylia xylocarpa*, *Artocarpus hirsuta* and *Swietenia macrophylla* gave the following results.

59. *Dalbergia latifolia.*—Early stump planting on 16th April 1934 in three experiments at three centres gave an average survival per cent of 71 and an average mean height growth of 23·6 inches after one season this, being an increase in height growth when compared with normal 1st June stumping of 55 per cent.

(For full experimental data see paragraph 264.)

Abbreviated data are as follows :—

Dalbergia latifolia.

Experimental garden.	Experiment number.	Year of formation.	Percentage of survivals after one season of stumps planted on						
			16th March 1934.	1st April 1934.	16th April 1934.	1st May 1934.	16th May 1934.	1st June 1934.	16th June 1934.
Kannoth ..	1 B	1934	..	74	98	88	96	92	90
Dhoni ..	41	1934	11	18	64	84	64	48	..
Topslip ..	47	1934	63	43	52	79	75	57	..

Experimental garden.	Experiment number.	Year of formation.	Mean height growth in inches after one season of stumps planted on						
			16th March 1934.	1st April 1934.	16th April 1934.	1st May 1934.	16th May 1934.	1st June 1934.	16th June 1934.
Kannoth ..	1 B	1934	..	23·4	26·2	23·2	25·1	19·3	15·4
Dhoni ..	41	1934	19·8	20·1	27·3	20·7	20·0	15·9	..
Topslip ..	47	1934	21·5	22·7	17·4	18·0	13·7	12·0	..

60. *Pterocarpus marsupium.*—Early planting on 16th April 1934 in three experiments at three centres gave an average survival percentage of 82 and an average mean height growth of 29·7 inches after one season, this being an increase in height growth of 26 per cent compared with normal 1st June stumping.

(For full experimental data see paragraph 265.)

Abbreviated data are as follows :—

Percentage of survivals afetr one season.

Experimental garden.	Experiment number.	Year of formation.	Percentage of survivals after one season of stumps planted on						
			16th March 1934.	1st April 1934.	16th April 1934.	1st May 1934.	16th May 1934.	1st June 1934.	16th June 1934.
Topslip ..	46	1934	71	72	87	81	85	85	..
Dhoni ..	40	1934	8	7	90	48	26	76	..
Kannoth ..	1 (C)	1934	..	38	70	88	100	96	82

Experimental garden.		Experiment number.	Year of formation.	Mean height growth in inches after one season's growth of stumps planted on						
				16th March 1934.	1st April 1934.	16th April 1934.	1st May 1934.	16th May 1934.	1st June 1934.	16th June 1934.
Topslip	..	46	1934	13·4	13·1	15·3	10·7	9·2	9·1	..
Dhoni	..	40	1934	17·9	42·9	27·1	19·8	17·5	17·5	..
Kannoth	..	1 (C)	1934	..	29·0	46·6	54·1	54·8	44·4	31·8

61. *Xylia xylocarpa.*—Stump planting on 16th April 1934 in two experiments at two centres gave an average survival per cent of 47 and an average mean height growth of 5·17 inches after one season, this being an increase of 107 per cent over normal 1st June stump planting.

It should be noted that growth of *Xylia* from stumps is poor. This species does better by direct sowing as is found in three experiments described below in paragraph 260.

(For full experimental data see paragraph 266.)

Abbreviated data are as follows :—

Xylia Xylocarpa.

Experimental garden.		Experiment number.	Year of formation.	Percentage of survivals after one season of stumps planted on					
				16th March 1934.	1st April 1934.	16th April 1934.	1st May 1934.	16th May 1934.	1st June 1934.
Topslip	..	48	1934	20	24	87	52	65	5
Dhoni	..	43	1934	0	16	6	42	28	2
				Average height growth in inches after one season of stumps planted on					
				16th March 1934.	1st April 1934.	16th April 1934.	1st May 1934.	16th May 1934.	1st June 1934.
Topslip	..	48	1934	3·45	3·17	5·00	2·94	2·71	2·00
Dhoni	..	43	1934	..	3·75	5·33	4·14	5·00	3·00

62. *Artocarpus hirsuta.*—Only one experiment was done with this species at Kannoth and this gave poor results as shown below :—

Experimental garden.		Experiment number.	Year of formation.	Percentage of survivals after one season of stumps planted on					
				1st April 1934.	15th April 1934.	1st May 1934.	15th May 1934.	1st June 1934.	15th June 1934.
Kannoth	..	1 (D)	1934	0	0	6	20	31	48
				Average height growth in inches after one season of stumps planted on					
				1st April 1934.	15th April 1934.	1st May 1934.	15th May 1934.	1st June 1934.	15th June 1934.
Kannoth	..	1 (D)	1934	0	0	12·4″	17·6″	14·2″	15·4″

The species does not stump very well in a good season and results are comparatively worse in a bad season.

63. *Swietenia macrophylla.*—One experiment was done with Mahogany at Kannoth and out of 600 stumps only 16 stumps sprouted at all. Most of these died off after the rains. This confirms previous results that the method of stumping is not suitable to Mahogany.

64. *Stump planting—Effect of age of stock used—Teak.*—The outturn of stumps from nursery beds sown with a known quantity of seed in April 1934 and October 1934 was recorded in two experiments at Dhoni and Anaipadi.

Results are as follows for 15 lb. of seed sown in a bed 10′ × 4′.

Number of stumps of the following diameter classes :—

	Measurement in April 1935.						
	0/0·1″	0·1″/0·2″	0·2″/0·3″	0·3″/0·4″	0·4″/0·5″	0·5″/0·6″	Total.
Dhoni April bed ..	..	..	..	314	216	172	702
Anaipadi April bed.	..	..	73	274	195	13	555
Dhoni October bed.	524	37	..	..	..	..	561
Anaipadi October bed.	100	79	11	..	..	..	190

The stumps produced by October beds are seen to be much fewer in number and much smaller in size.

65. In three planting out tests similar results were obtained, the October bed stumps producing many fewer plants with a smaller mean height growth after one season. This result was significant in two cases and nearly significant in the third case. The above confirms previous year's results.

(For full experimental data see paragraph 267.)

66. *Stump planting—Effect of diameter of stumps—Teak.*—In continuation of last year's experiments three experiments were done in three different localities using stumps from plants of one and two years old and from 0·3 inch to 2·0 inches diameter. Results confirm last year's indications that stumps do best if from 0·4 inch to 0·8 inch diameter at the collum (0·6 inch to 0·9 inch diameter at the thickest part approximately) and within this range of diameter there appears to be little difference between one-year and two-year old stumps.

Abbreviated results are as follows :—

Survival percentage after one season.

Diameter of stumps in inches.	0·3/0·4	0·4/0·5	0·5/0·6	0·6/0·7	0·7/0·8	0·8/1·0	1·2/1·4	1·8/2·0
One-year old	85	..	84	..	84	..	..	..
One-year old	76	89	94	96	..	..	..	..
One-year old	56	..	79	..	71	58	..	..
Two-year old	..	..	..	..	70	72	68	30
Average ..	72	89	86	96	75	65	68	30

Height growth after one season in inches.

		0·3/0·4	0·4/0·5	0·5/0·6	0·6/0·7	0·7/0·8	0·8/1·0	1·2/1·4	1·8/2·0
Dhoni	One-year old ..	11·39	..	12·33	..	13·11	..	..	..
Topslip	One-year old ..	19·87	19·19	19·83	25·43	..	..	..	..
Begur	One-year old ..	7·56	..	8·16	..	9·60	10·08	..	..
Begur	Two-year old and three-year old.	..	..	..	..	12·48	11·40	11·04	8·16

NOTE.—In height growth each experiment should be considered separately.

(For full experimental data see paragraph 268.)

67. *Dalbergia latifolia.*—Experiments at Topslip and Begur confirm last year's indications that stumps of 0·2 inch to 0·4 inch collum diameter are best (or even possibly larger) age has apparently a small effect and if of the same size two-year stumps have done better than one-year old stumps.

Abbreviated results are—

Percentage of survivals after one year.

Diameter of stumps in inches.		0·1	0·1″/0·2.	0·2″/0·3	0·4
Topslip.	One-year old ..	..	30	58	..
	Two-year old ..	..	56	74	..
Begur	One-year old ..	49	83	74	..
	Two-year old ..	..	81	92	93
Average ..		49	63	75	93

Height growth after one season in inches.

Diameter of stumps in inches.		0·1	0·1″/0·2	0·2″/0·3	0·4
Topslip.	One-year old ..	..	13·40	18·21	
	Two-year old ..	..	15·46	20·57	
Begur.	One-year old ..	6·24	6·48	8·64	8·04
	Two-year old ..	..	6·96	6·96	

NOTE.—In height growth each experiment should be considered separately.

(For full experimental data see paragraph 269.)

68. *Pterocarpus marsupium.*—Six sizes of stumps from 0·1 inch to 0·8 inch in diameter and one and two years old were compared. Results indicate that the older and larger in diameter the stump is the better the results will be (within the range tried).

(For full experimental data see paragraph 270.)

69. *Terminalia crenulata.*—Indications are that stumps from 0·4 inch to 0·8 inch collum diameter do best as regards survival per cent and mean height growth and within this range it does not matter whether the stumps are one or two years old.

Smaller diameters and larger diameters than this range showed much smaller survival per cent and also smaller mean height growth.

(For full experimental data see paragraph 271.)

70. *Artocarpus hirsuta.*—Stumps one and two years old from 0·02 inch to 0·06 inch collum diameter were experimented with. Results indicate that within this range the older and bigger the stumps the better the results. The best diameter is probably above this range.

(For full experimental data see paragraph 272.)

71. *Stump planting—Effect of length of root—Teak.*—Four experiments in four different centres were done in repetition of previous year's experiments The experiments were with two diameters of stumps 0·3 inch–0·4 inch and 0·7 inch–0·8 inch and root lengths of 4 inches, 6 inches, 8 inches and 10 inches for each of the two diameter classes used. The present normal stump root length of 8 inches was taken as control.

72. This year's results have confirmed previous year's results that there is apparently no definite relationship between the root length of stumps (within the range of 4 inches to 10 inches) and either the resulting survivals or mean height growth.

73. Although not the primary object of the experiment, another indication is seen from the results. Comparing the two diameter classes of stumps used and taking all root lengths together, the

0·3 inch–0·4 inch diameter stumps gave an average survival per cent of 59 and a mean height growth of 8·8″ and the 0·7″–0·8″ stumps 81 per cent and 11·6″. This is a very definite indication that it is better to use a larger diameter stump than 0·3″–0·4″ as the result is an average of 1,600 stumps in each case.

(For full experimental data see paragraph 273.)

74. *Stump planting—Comparison of pits and crowbar holes—Teak.* Four experiments were done in four localities one of the experiments being in a ponam crop of hill paddy.

In each of these experiments three types of soil working for stump planting were tried (*a*) standard 1′ cube pits (*b*) crowbar holes and (*c*) the soil loosened at the stake and a crowbar hole made in the centre.

75. In all cases standard pits gave a slight but not significant increase in height growth (average 9 per cent). There was practically no difference in the other two treatments. There was also practically no difference between the three treatments as far as percentages of survivals were concerned.

76. This confirms previous year's indications that for stump planting the preparation of pits is not worth the extra expense. This result probably applies only to the soil conditions found in the good quality mixed deciduous forests, viz., a light porous sandy loam of gneissic origin with a high humus content.

(For full experimental data see paragraph 274.)

77. *Stump planting—Effect of cooly variation—Teak.*—

Experiment 4. Kannoth experimental garden was done to find out what was the effect of looseness or tightness of stump planting by different coolies. The following planting was done :—

(*a*) By the Provincial Silviculturist, tight round the top only.

(*b*) By the Research maistry purposely loose all round.

(*c*) By an expert planting cooly as well as he knew how to do it.

(*d*) By an inexperienced cooly—a farmer.

(*e*) By an inexperienced cooly—a blacksmith.

78. There was practically no difference in survival percentage and no significant difference in mean height growth after one season between all these treatments.

This experiment was done in a ponam crop of hill paddy.

79. *Stump planting—Storage of stumps—Teak.*—Three experiments in 3 centres were done in which Teak plants were dug up from the nursery at intervals of five days made into stumps and stored in well ventilated rooms tied in bundles. The period of storage ranged from 0 to 35 days.

Survival percentage after one season were as follows :—

Period of storage before planting.	Percentage of survivals at Begur.	Topslip.	Dhoni.	Average.
0	88	95	92	92
10	84	64	87	78
15	85	45	77	69
20	51	60	91	67
25	3	24	73	33
30	10	23	59	31
35	15	19	19	18

80. It is thus seen that stumps can be made and stored for three weeks and still show a reasonable survival percentage when planted. This means that stumps can be sent from any part of this Presidency to any other without fear of serious deterioration.

For full experimental data see paragraph 275.

81. *Stump planting—Transport of stumps—Teak.*—Experiments were initiated to determine whether (1) teak stumps would travel without deterioration and (2) whether stumps from one locality would thrive in another locality often of a different climate.

82. Stumps were sent from Nilambur to (1) Topslip (Anamalais) where they showed much better survivals and a significantly better mean height growth (21 per cent) than local stumps (2) Begur (Wynaad) where they showed much better survivals and again a significantly better mean height growth (31 per cent) than local stumps (3) to Walayar (Palghat Division) where they showed a smaller percentage survivals and a better but not significant height growth (5 per cent) than local stumps. In addition to the above Nilambur stumps were sent to Tinnevelly district where the District Forest Officer reports that they are doing quite as well as local stumps, Upper Godavari Division where the District Forest Officer reports they are not doing as well as local stamps and to North Mangalore Division where they definitely failed owing to the length of the journey and the fact that they arrived on April 26th and no rain at all fell till June 7th, i.e., nearly two months after leaving Nilambur.

(For full experimental data see paragraph 276.)

83. *Best size of transplants—Swietenia macrophylla.*—As mahogany does not stump well and as transplanting has been found to be the best method of regeneration for the species an experiment was tried using 3 sizes of transplants 9″, 18″ and 30″.

Results showed that the 30″ transplants suffered heavy casualties while the other two sizes had roughly the same casualties. The mean height measurements at transplanting and one year later were

	Initial.	One year after.
A	9″	15·84″(±4·44).
B	18″	19·8″ (±1·80).
C	30″	25·8″ (±4·2) (decrease due to dying back and putting up fresh shoots).

84. It is thus evident that the smallest size (9″) transplants are the best to use. This indication is confirmed by similar experiments with this species under evergreen cover.

This experiment (Kannoth Experimental Garden No. 7) was done in a ponam crop of hill paddy.

85. *Teak plantations—Casualty replacement.*—In teak plantations in places having the west coast type of climate it has been suspected that second year casualty replacements do not take their place in the crop. An investigation has been made into this subject and although it is too soon to be definite the indications are that second year replacements do not take their place in the crop and therefore are not financially worth while.

86. The following table shows the results obtained so far. It should be noted that in only one out of four experiments have more than 50 per cent of the replacements lived for one year and even in this case, at the end of the 4th year of the plantation the replacements had only reached half of the height of the plantation. The experiments are being continued and extended.

District.	Experiment.	Area.	Year of casualty replacement.	Number of casualties replaced in the second year.	Percentage of orginal planting replaced.
(1)	(2)	(3)	(4)	(5)	(6)
		ACRE.			
South Coimbatore	E.P. No. 199	½	1932	244	40
Do.	E.P. No. 141	½	1934	121	20
Palghat	E.P. No. 135	2	1933	316	13
Do.	E.P. No. 140	½	1934	198	33

At the end of the third year.		At the end of the fourth year.	
Percentage of casualties surviving.	Proportion of average height of replacements to average height of plantation.	Percentage of casualties surviving.	Proportion of average height of replacements to average height of plantation.
(7)	(8)	(9)	(10)
20	1/8	19	1/5*
17	1/5	..	..
77	1/6	62	1/2
48	1/6	..	..

Remarks—Since destroyed by fire.

87. *Teak coppice forest—Filling in of blanks with stumps.*—An attempt was made in experimental Plot 47 of Palghat Division to fill in fairly small blanks in a teak coppice forest by using teak stumps at the time of felling. This was done in 1926 over one acre. In 1935 after 9 years (or nearly ⅓ of the rotation of 30 years) 55 per cent of the plants from the stumps were still surviving but were only ½ the girth and slightly over ½ the height of the coppice poles. Although these stump plants have not taken their place in the crop yet, if they survive to the end of the rotation they will coppice and the object of their introduction will have been achieved. This however does not appear likely as they are now heavily suppressed.

88. *Effect of taungya (ponam) crops on the growth of teak in a plantation.*—In last year's Annual Report paragraph 64 the retarding effect of a taungya (ponam) crop of " Ragi " (Eleusine coracana) was demonstrated by Experimental plot 11 of Wynaad Division. This experiment showed that the ponam crop while not affecting the survival percent of the teak has caused a retardation of growth to the extent of approximately 30 per cent.

89. In experimental Plot No. 17, Wynaad, this experiment has been repeated and shows a retarding effect of 18 per cent using ragi as the ponam crop which causes an intense competition with the teak, but with dhall (Cajamus indicus) a leguminous crop, the teak showed an improvement of 17 per cent. This needs confirmation by further experiment.

90. This Experimental Plot is being further used to see whether this deleterious effect of ragi in the first year can be counteracted by the use of cover crops such as " Sunnhemp " (*Crotolaria Juncea*) and " Boga " (Tephrosia candida) in the second year.

(For full experimental data see paragraph 277.)

91. *Premonsoon stump planting of teak with a taungya crop.*—To ascertain how far the retarding effect of a taungya crop of ragi on the growth of the teak could be counter-acted by earlier planting of teak stumps an experiment (Experimental Plot 10, Wynaad Division) was done comparing (*a*) early planting on 21st April and (*b*) late planting on June 1st with a taungya crop of ragi. The arrangement was the same as Experimental Plot No. 11 (vide previous paragraph).

92. Measurements reported last year showed that plants resulting from the early planted stumps were 103 per cent better in height growth in the following hot weather than the plants from late planted stumps.

93. Remeasurement this hot weather 14th February 1935, i.e., at the end of the second year showed that they were still 85 per cent better.

Treatment.	Survival per cent.	Mean height in feet.	Difference in favour of early planting.
Early planting—21st April 1933	96	3·37 ± 0·36	1·55 ± 0·05 S
Late planting—1st June 1933	84	1·82 ± 0·40	

94. *Comparison of early and late stump planting of teak in a plantation with and without a ponam crop of ragi.*—Experimental Plot 18 of Wynaad division had as its object the combining of the results of the above two paragraphs. The plot had four treatments (A) early planting with a ponam crop (B) early planting without a ponam crop (C) late planting with a ponam crop and (D) late planting without ponam.

The early planting was done on 21st April 1934 and the late planting on 23rd May 1934. Ragi was sown in A and C on 26th June 1934.

95. Results show that (1) the ponam caused a retardation in mean height growth of the teak of 7 per cent with the late planting and an increase of 6 per cent with early planting (the latter probably due to soil working to introduce the ponam crop).

(2) Early planting was 182 per cent better in height growth than late planting when there was a ponam crop and 148 per cent better when there was no ponam crop.

(For full experimental data see paragraph 278.)

96. *Effect of planting espacement on the height growth of the teak and on the cost of weeding.*—An experiment (Experimental Plot 21, Wynaad) with this object was started during the year with two espacements 3′ × 3′ and 6′ × 6′. Measurements in March 1935 showed an increase in the height growth of the teak of $1\frac{1}{2}$ per cent (not significant) in the 3′ × 3′ planting compared with the 6′ × 6′ area.

By the end of the year the 3′ × 3′ area had not closed up and weeding costs were very similar. The effect of the close planting will probably show more in the next two years.

(*b*) *Evergreen rain forests.*

97. All the artificial regeneration experiments done in evergreen rain forest have been planting under shade and are therefore reported in part (ix) of this Chapter "Underplanting" below (paragraphs 152 to 170).

(*c*) *Dry fuel forests.*

98. Research in the problems of the artificial regeneration of dry fuel forests is being continued. At the end of last year the Research centre at Chittoor was given up as it was thought not to be typical of the areas for which the results of the experiments were intended as conditions were too rigorous. During the year the new research centre at Emmanur near Satyamangalam in North Coimbatore division got into full swing and experiments have started to give results as shown below. It should be noted that in these dry fuel areas the rainfall is very variable both in quantity and season year by year and in consequence all results and indications must be accepted with caution as they need many repetitions.

99. Research into these dry fuel forest regeneration problems is only in an initial stage and in general, detailed working of significance has not been considered necessary as at present the experiments are only intended to give us indications of the direction of further work. Further it is not for two or three years that plants can be considered established.

100. In brief the main indications are—

I. Artificial regeneration by any method is best done at the beginning of the North East Monsoon (usually early October) except possibly where watering is possible.

II. With most species entire transplanting is the best method while with a few species direct sowing gives the best results.

III. Stump planting is not a suitable method for this type of forest.

IV. The following species may be regarded as hopeful as they have all given over 50 per cent survivals at the end of the first year. (Please see Annual Report, 1933–34, paragraph 71, for Chittoor indications.)

(*a*) By entire transplanting.

Acacia ferruginea.
Acacia leucophloea.
Albizzia amara.
Azadirachta indica.
Holoptelia integrifolia.
Prosopis juliflora.
Soymida febrifuga.

(*b*) By direct sowing.

Cassia siamea.
Tamarindus indicus.

101. A certain amount of uncertainty has been experienced in deciding which is the best season for artificial regeneration operations in dry fuel forests which have a little of both the south-west and north-east monsoons and in consequence many of the experiments done in Emmanur Experimental Garden (North Coimbatore division) during the year had this point as one of their main objects.

District work.—District work continues to be done on an increasing scale with correspondingly better success as the technique improves.

The District Forest Officer, Chittoor division, reports that " rab " sowings of 1933 now (after two years) show 33 per cent of the plots established with *Cassia siamea, Acacia sundra, Azadirachta indica, Albizzia amara* and *Tamarindus indicus* the height growth being generally 4′–12′.

In Chittoor division in last year's work the most successful results have been with rab plots roughly 50′ × 20′ regenerated with a *Cassia siamea* surround and *Albizzia lebbek, Albizzia stipulata, Acacia sundra, Zizpyhus jujuba* in lines alternating with *Wrightia tinctoria* and *Dolichandrone crispa* inside this surround. The latter species being introduced as described as thick foliaged species for soil protection.

102. *Direct sowing—best season.*—Experiment 1 (i) Emmanur Experimental Garden had as its object the determination of the best season for direct sowing of five species *Acacia ferruginea, Acacia sundra, Anacardium occidentale, Albizzia amara* and *Cassia siamea* and in all these cases taking percentage of survivals and mean height growth into consideration it was found that early October was the best date. With earlier sowings only part of the seed

germinates in the South-West monsoon and the balance in the North-East monsoon but quite a number of casualties occur in the period between the monsoons should a dry hot spell intervene.

(For full experimental data see paragraph 279.)

103. *Direct sowing—Comparison of dry beds and watered beds.*—Experiment 1 (ii) Emmanur Experimental Garden was supplementary to Experiment 1 (i) mentioned in paragraph 102 above and was designed to discover whether the best date of direct sowing was different when the beds were watered. Results showed in general that although the stocking of the beds sown in the South-West monsoon was greatly improved by watering it was not as good as that obtained in beds sown in the North-East monsoon. Many of the inter-monsoon casualties were saved by this watering and of course a greatly increased height growth was obtained. The indication of the experiment is that where watering is possible the resulting gain in height growth by the following hot weather makes such an expensive operation as watering worth while where good stocking is needed quickly.

(For full experimental detail see paragraph 280.)

104. *Direct sowing—Comparison of (a) not burning but soil working, (b) not burning and no soil working, (c) burning and soil working, (d) burning and no soil working.*—In Experiment *No.* 5 Emmanur Experimental Garden, four treatments were applied in two of which the area was burned and the ash worked into the soil before sowing and in the remaining two no burning was done. In each of these two pairs of treatments, in one the soil was worked 9″ × 9″ × 6″ before sowing and in the other only enough soil working to sow the seed was done. Results show from the percentage of survivals and mean height growth that burning the area before sowing is beneficial but that while soil working before sowing gives in general a slightly better height growth yet casualties are greater than if there were no soil working. The indication is that burning is worth while though soil working is of doubtful utility.

(For full experimental detail see paragraph 281.)

105. *Direct sowing—Comparison of sowing untreated seed and germinating seed.*—Initial stocking in artificial regeneration operations in dry fuel forests is often very poor and experiment No. 6, Emmanur Experimental Garden, was devised to endeavour to get over this difficulty. The seed of eight species was placed between layers of straw, weights put on the top and the pile watered copiously to induce germination. As soon as the seeds germinated they were sown and results contrasted with untreated controls.

By the following February there was very little difference in mean height growth of the resulting plants but in the case of *Acacia ferruginea, Acacia sundra, Prosopis juliflora* the survival percentage of plants from the germinating seed was definitely greater than that from untreated seed while with *Acacia cyanophylla, Cassia*

fistula and *Cassia marginata* there was little or no difference. There were too few survivals of *Pterocarpus santalinus* to draw any conclusions.

(For full experimental details see paragraph 282.)

106. *Comparison of sowing entire transplanting and stump planting.*—In Experiment No. 4 of Emmanur Experimental Garden ten species were experimented with by trying to raise them by direct sowing, entire transplanting and stump planting. Results show that stump planting is *not* a suitable method of regeneration in dry fuel forests as few of the species will produce shoots which will survive the first hot weather. In the case of *Cassia siamea* and *Tamarindus indicus* direct sowing gave the best mean height growth and best percentage of survivals while for *Acacia ferruginea*, *Acacia leucophloea*, *Acacia sundra*, *Albizzia amara*, *Azadirachta indica*, *Holoptelia integrifolia*, *Prosopis juliflora* and *Soymida febrifuga* entire transplanting is the best method to adopt.

(For full experimental details see paragraph 283.)

107. *Stump planting and transplanting.*—Experiment No. 2 of Emmanur Experimental Garden had for its objects (*a*) to find the best season for stump planting, (*b*) to compare stump planting and transplanting and (*c*) to compare transplanting at the commencement of the South-West and North-East monsoons. Of the five species experimented with only one, *Chloroxylon swietenia*, showed any promise of stump planting and even with this, survivals with stump planting were very poor compared with transplanting.

108. The indications of the experiment are (1) stump planting is not suitable for dry fuel forests, (2) transplanting is in every way more successful than stump planting and (3) transplanting at the beginning of the North-East monsoon (early October) gives very much better results than transplanting at the beginning of the South-West monsoon (June–July).

(For full experimental data see paragraph 284.)

109. *Stump planting—Best date.*—In Experiment No. 8, Emmanur Experimental Garden, 12 species were stump planted on five dates from July to end of November to determine the best date of stump planting. Out of the 12 species, only 4, *Cassia siamea*, *Dolichandrone crispa*, *Holoptelia integrifolia* and *Wrightia tinctoria* showed any promise for the method of regeneration and for all the best percentage of survivals was of those stumps planted in early October. Other experiments, some of which have been mentioned above, show that even for these species better results can be obtained in most cases by transplanting and in some by direct sowing.

(For full experimental details see paragraph 285.)

110. *Direct sowing of santalum album in the open and under bushes.*—In Experiment No. 7 of Emmanur Experimental Garden seed of *Santalum album* was sown with and without dhall and in the open and under bushes. The best results were obtained without dhall under bushes but all seedlings died out during the exceptionally prolonged hot weather this year. The experiment is being repeated.

111. *Direct sowing—Effect of root competition.*—In Experiment No. 10 of Emmanur Experimental Garden blanks were selected in two fuel series (Bennari and Kottamangalam) in coupes which were due for felling in ten years. Seeds of six species were sown in prepared patches in the blanks. Half of these patches were protected from the root competition of the surrounding forest by trenches.

112. The root competition seemed to have little or no effect on the percentage of survivals or on the mean height growth during the first year. Unfortunately at the end of the first year half of this experiment was destroyed by the trampling of wild elephant.

(For full experimental detail see paragraph 286.)

113. In a similar experiment (Emmanur Experimental Garden Experiment No. 11) in which *Eugenia jambolana* was tried there were no survivals. Germination was very poor due to infertile seed.

114. *Stump planting—Santalum album.*—In North Salem division where most of the spike disease research is going on, a large number of sandal plants of known age are needed for experimental purposes. As a consequence of this need an interesting technique has been evolved which is worthy of note.

115. Suitable mother trees are selected in the forest and all regeneration under them is pulled up. The ground under them is dug up to a depth of about 4 inches. After the next seed fall a mass of regeneration comes up under the tree which is removed and stump planted as and when required. In the stump planting 1 inch to 4 inches of shoot and 6 inches to 9 inches of root is left and the stump is either planted near a suitable host in a previously prepared bed or planted with a host if the host is a bushy rooted species or if the intended host plant stumps well the 2 stumps are tied together and planted. During the last four years sandal has been stumped from one to four years old and results have shown 85 to 95 per cent success.

(*vii*) Afforestation.

116. *Grass land catchment areas.*—Experiments were started during the year to examine the possibility of reafforesting the important catchment areas of the Nilgiris, preferably with shola species. Past experiments by the division on a fairly large scale indicated that conditions on the more exposed parts of the hills were too severe to hold out much prospect of success unless supported by previous research on the best species and best methods to use. Two plots were chosen one at Jacko's Nalla and one at Brooklands and experiments were conducted to endeavour to raise from seed certain tree species and shrubby species—the latter to serve as nurses to the less hardy tree species.

117. Frosts started exceptionally early—8th to 10th November and caused great havoc and among all the species tried only two shrubs broom (*Citysus scoparius*) and Gorse (*Ulex europeus*) successfully withstood the frost of the cold weather and the drought of the

hot weather. Of the tree species *Acacia melanoxylon, Callitris rhomboidea, Cupressus macrocarpa, Eugenia arnottiana Ternstrœmia japonica* germinated in large numbers but only the first named of these has shown any promise of recovery after the frost. *Daphnyphyllum glaucascens* seed did not germinate in the first year but did so in the second year after lying dormant in the soil.

118. Of the nurse species in addition to broom and gorse, *Cassia tomentosa* and *Dodonea viscosa* germinated well but were easily killed by the frost. Among the tree species *Evodia roxburghiana, Hakea saligna, Neolitsea zeylanica* and *Pavetta breviflora* germinated well but succumbed to frost. *Rhodomyrtus tomentosa, Rhododendron arboreum, Wendlandia notoniana* and *Myrsine wightiana* did not germinate at all.

119. The experiments are being continued in both localities and in addition to direct sowing, transplanting with mossed and naked root seedlings, root cuttings, shoot cuttings, and root and shoot cuttings are also being tried.

120. *Swamp edges.*—An experiment has been started to see whether cricket bat willow *Salix cœrulea var. alba* will thrive in the Nilgiris. Cuttings were got out from England and eventually arrived on June 5th after an adventurous journey. They suffered three weeks in cold storage on the boat followed by some ten days astray in Bombay during May and then when discovered the tins were opened and fumigated with carbon bisulphide by the customs. In spite of this severe treatment within ten days of planting 87 per cent produced shoots and now (August 15th) some 50 per cent are alive and looking very healthy, with shoots up to 6 inches to 8 inches high. It is to be seen whether they will survive the frost and the hot weather.

(*viii*) TENDING, THINNING, CLEANING, ETC.

121. *Effect of leaving unweeded—Dalbergia latifolia.*—The experiment of last year was repeated and results this year do not confirm the indications of last year. In this year the survival percentage and mean height growth of the unweeded lines show no significant difference from those weeded.

For full experimental data see paragraph 287.

122. *Weeding practice—Teak plantation—First year.*—To confirm or otherwise results of previous years in this subject an experiment (Experimental Plot 139 of South Coimbatore Division) was done in which three methods of weeding were compared in the first year of a teak plantation.

123. The methods used were—

(A) Mamuti scraping in lines 2 feet wide on each side of the plants and each subsequent scraping to be at right angles to the previous one.

(B) Forking in lines 2 feet wide on either side of the plants to be done as for scraping.

(C) Control weed cutting only with hand pulling round the plants to a distance of one foot.

124. Initial comparability was established and costs for each treatment carefully kept. Measurements in February 1935 (at the end of the first year of treatment) showed—

(1) that there was no appreciable difference in survival percentage between the three treatments.

(2) Forking resulted in a mean height growth slightly but just significantly superior to the control weed cutting.

(3) Mamuti scraping was slightly but not significantly poorer than weed cutting.

(4) Costs for the first year were in the proportion Mamooty scraping : Forking : Weed cutting : 1·4 : 2·2 : 1.

The detailed figures are given below :—

Treatment.	Survival per cent.	Mean height in inches.	Difference of means.	Significance.	Remarks.
A. Mamuti scraping.	91	33·90 ± 1·55	−3·97 ± 2·16	N.S.	(1) Initial comparability was established.
B. Forking ..	93	42·45 ± 1·67	+ 4·58 ± 2·26	Just S.	(2) Measurements in February 1935.
C. Weed cutting only.	89	37·89 ± 1·51	Control.		

125. This result on weeding methods from larger scale Experimental Plots is confirmed by three Experimental Garden experiments conducted at Topslip and Dhoni during the year. In these experiments forking was compared with mamuti scraping as weeding methods.

126. In all three cases there was no appreciable difference in survival per cent in the two methods but in two cases forking produced significantly poorer and in one case slightly but not significantly better height growth.

Abbreviated results averaged after one season are—

	Percentage of survivals.		Mean height in inches.		
	Scraped.	Forked.	Scraped.	Forked.	
Topslip Experimental Garden No. 61.	97	93	51·34	41·70	Difference significant.
Dhoni Experimental Garden No. 57.	97	97	18·18	18·39	Not significant.
Dhoni Experimental Garden No. 49.	99	100	15·25	12·60	Difference significant.
Average ..	98	97	28·26	24·23	Average difference 16 per cent.

(For full experimental data see paragraph 288.)

127. *Weeding practice—Teak plantation—Second year.*—Two experiments (Experimental Plots 130 and 131, Nilambur Division) were done to confirm or otherwise previous years results in which forking was compared with scraping as the method of weeding a teak plantation in its second year.

128. The forking and scraping were done as described in the paragraph above. In both these experiments initial comparability was established and at the end of the year they exhibited a similar result, viz., the forking had produced a slight but not significant increase in mean height growth and therefore had not been worth the extra expense. The actual increases were 4 per cent and 9 per cent in the two cases.

129. The above results are important as they confirm the indications of previous years that the small gain due to forking is not worth the expense of the operation. The saving by weeding by weed cutting or scraping in preference to forking is approximately Rs. 3 to Rs. 4 per acre each time the operation is done.

130. Experimental Plot 14, Wynaad Division, in which a teak plantation was kept clean weeded during its first year was continued and kept clean weeded in its second year also.

The clean weeded plot showed a percentage increase in mean height growth over the normally weeded control of 103 per cent in the first year and 165 per cent in the second year both results being very significant.

131. The cost of clean weeding was Rs. 31–9–0 per acre at the end of the first year and Rs. 46–11–0 up to the end of the second year.

This operation is not of course a practical one owing to its prohibitive cost but is an excellent proof of the retarding effect of weeds.

132. It should be noted that these results on weeding practice showing that the small beneficial effect of soil-aeration by forking is not economically justified have all been obtained in clear-felled areas in mixed deciduous forest of good quality, with a soil a light friable loam and rainfall 60 to 100 inches. We do not know whether they apply to dry areas with a small rainfall and a prolonged hot weather. Experiments have been started to test this but we have no results yet.

133. *Effect of burning and cutting back a teak plantation in the hot weather after planting.*—Experiments in this subject were repeated with the burn carried out earlier—Experimental Plot 16, Wynaad, on 12th April 1934, Experimental Plot 136, South Coimbatore, on 27th March 1934.

In both these experiments results again show that cutting back either with or without burning gives a poorer mean height growth than the control which was left alone. Results also again show that cutting back with burning gives better results than cutting back without burning. In other words this means that burning does stimulate the teak. With the earlier burning this year's experiments show much smaller differences from the controls.

The experiment is again being repeated with still earlier burning.

Experimental data is given in paragraph 289.

134. *Cover crops—Tephrosia candida introduced in the first year of a teak plantation.*—An experiment at Nilambur (Experimental Plot No. 124) in introducing "Boga" (*Tephrosia candida*) in the first year of a teak plantation indicated that the boga crop (sown in May 1933) was troublesome and harmful. Not only had the boga to be weeded to start with but it had to be cut back four times during the year to protect the teak which cost as much as the weedings in the control strips. The effect of boga on the teak was bad, survivals were fewer and the height growth significantly poorer (17 per cent).

During the second year the boga did quite well but only towards the end of the year was it really suppressing weeds. It had to be cut back twice in the year to protect the teak.

135. Measurements in February 1935 showed the boga-teak still significantly behind the control teak to the extent of 34 per cent.

Date of measurement.	Treatment.	Survival per cent.	Mean height in feet.	Difference.	Signi-ficance.
May 1934 ..	.. Boga strips ..	84	2·03 ± 0·10	− 0·40 ± 0·14	S.
	Control strips ..	99	2·43 ± 0·09	Control.	
February 1935	.. Boga strips ..	74	5·10 ± 0·24	− 2·63 ± 0·35	S.
	Control strips ..	84	7·73 ± 0·25	Control.	

136. *Tephrosia candida introduced in the second year of a teak plantation.*—In an experiment at Nilambur (Experimental Plot No. 128) in which boga was introduced in the second year the boga had a retarding effect on the teak of 11 per cent but during the year only reached the height of the teak and did not have to be cut back. It also did a certain amount of weed suppression.

It is to be seen whether this retarding effect lasts into the third year. The two treatments were initially comparable. Measurements in February 1935 (i.e., the end of the first year of the boga and second year of the teak) showed—

Treatment.	Survival per cent.	Mean height in feet.	Difference of means.	Significance.
Boga strips	94	6·02 ± 0·14	−0·59 ± 0·22	S.
Control strips	95	6·61 ± 0·17	Control.	

137. In a similar experiment in the Wynaad Experimental Plot 12 started in 1933, measurements in 1934 and 1935 showed the teak in the boga lines significantly superior in mean height growth to that in the control lines to the extent of 28 per cent and 22 per cent in the years mentioned. In this plot however the boga was constantly browsed by bison and never was more than 2 feet high. Under these circumstances it is very doubtful if the improvement in the teak can be put down to the boga. It is more probably due to the extra soil working and attention the boga lines inevitably must have had.

138. *Leucaena glauca introduced in the second year of a teak plantation.*—In Experimental Plot 19, Wynaad, *Leucaena glauca* was introduced as a cover crop in the second year of a teak plantation to see what effect it would have on the teak and on weed suppression.

Although initial germination of the crop was quite good yet all through the year it was browsed and trampled on by bison and sambhur. Hence there are no results to record.

139. *Dhall (cajanus indicus) introduced in the second year of a teak plantation where there had been and had not been a crop of ragi (Eleusine coracana) in the first year.*—In Experimental Plot 20, Wynaad, in the first year there were four plots in two of which there had been a ponam crop of ragi with the teak and in the other two plots no crop of ragi. These were selected so that measurements were comparable at the end of the first year (i.e., after the ragi crop had been harvested). In one of the ragi plots and one of the non-ragi plots dhall was cultivated in the second year.

140. Where dhall was cultivated after no ponam there was a slight but not significant retardation in the height of the teak (3 per cent) and where dhall followed the ragi crop a slight but not significant increase in the height of the teak (12 per cent). This increase would naturally occur following the freeing of the teak from the densely rooted ragi crop. In other respects it was evident that dhall is no use as a cover crop when sown in the second year for even if not browsed it does little or no suppression of weeds.

141. *Thinning research.*—Twenty-seven thinning plots were laid out at Nilambur in accordance with the scheme drawn up with the Central Silviculturist for the initiation of Research into the best grades and cycles of thinning teak plantations. Similar plots are being laid out at Begur in the Wynaad this year.

142. *Effect of soil working and of trenching on growth of natural seedlings of Hopea parviflora.*—Two experiments (Experimental Plots 124, 125, South Coimbatore Division) were done one under full evergreen shade and the other in a plot where the undergrowth and all trees except those in the upper canopy had been removed. The effect of (A) soil aeration by forking 3 inches deep in 3 feet strips, (B) removal of root competition by digging narrow trenches 9 inches deep and 3 feet apart with similar cross trenches at 4 feet intervals and cutting of all roots met with, and (C) no treatment were compared.

143. In the shaded plot after two years no appreciable difference in survivals or in mean height growth was found between the three treatments. In the plot in top canopy shade growth was much quicker and in the second year both treatments were significantly better in mean height growth than the control. Soil working and trenching produced height growth 160 per cent and 136 per cent respectively better than control.

It appears therefore that soil working with natural regeneration of *Hopea* is beneficial.

(For full experimental detail see paragraph 290.)

144. *Effect of burning a Eucalyptus globulus fuel plantation after coppicing.*—An experiment has been started in the Nilgiris in which a blue gum fuel area was burned after being coppiced as it

is thought that this treatment will possibly cause the new shoots to emanate from the base of the stool rather than higher up the stool. Initial comparability was established between the areas before felling. Results are awaited.

145. *Cutting of thorny bushes in dry fuel coupes at the time of felling.*—An experiment done by the Working Plans Officer, Vellore, indicates clearly that the cutting of thorny bushes such as *Indigofera paucifolia, Zizyphus œnoplia, Carissa carandus, Randia dumetorum, Zizyphus jujuba* and *Gymnosporia montana* in a dry fuel coupe at the time of felling definitely and greatly increases the pest.

(*ix*) MIXTURES—Nil.

(*x*) UNDERPLANTING.

(*a*) *Teak plantations.*

146. *Underplanting in Teak plantations.*—No new work has been done. In the old plots at Nilambur in which *Cephalostachyum pergracile* (Experimental Plots 100, 104 and 105 of 1930 and Experimental Plot 106 of 1931) *Bambusa arundinacea* (Experimental Plot 101 of 1930), *Swietenia macrophylla* (Experimental Plots 98 and 102 of 1930) and *Cedrela toona* (Experimental Plots 99 and 103 of 1930) were introduced, the two bamboos show promise, are now well established and are growing fast. The *Swietenia* and *Cedrela* have suffered from browsing but the larger plants are now established and growing quite well. In Experimental Plot 8, Wynaad Division, *Cephalostachyum pergracile* was sown in 1932 under teak 33 years old the bamboo suffered very badly from browsing though the number of survivals was good. This plot was fenced early in the year and the bamboo is now going ahead.

147. The following table shows the progress made by the species mentioned above :—

Division.	Experimental Plot number.	Species.	Date of formation.	Mean height in Feburary 1935 in feet.
Nilambur	98	Mahogany	1930	4·3
	102	Do.	1930	1·8*
	99	*Cedrela toona*	1930	4·3
	103	Do.	1930	4·0
	101	*Bambusa arundinacea*	1930	9·3
	100	*Cephalostachym pergracile* ..	1930	16·8
	104	Do.	1930	15·6
	105	Do.	1931	18·3

* Heavily borrowed.

(*b*) *Evergreen rain forests.*

148. *Underplanting under shade.*—Experimental Plots 36 and 37, Palghat Division, in which *Mesua ferrea* and *Calophyllum elatum* were transplanted under evergreen forest shade in 1924 are well stocked with healthy saplings which continue to grow steadily. The average heights in February 1935 were *Calophyllum elatum* 3′ 10″ and *Mesua ferrea* 3′ 3″ being increments during the year of 7″

and 4″ respectively. These two Experimental plots have been closed as Regeneration Experiments and parts of them are being reopened as plots to observe the development from the sapling stage to the pole stage.

149. *Effect of burning before artificial regeneration in gaps in evergreen forest.*—In Experimental Plot 130, South Coimbatore Division, ten gaps were selected for regeneration in evergreen forest and half of these gaps were burned over before regenerating them. Three species were used—*Acrocarpus fraxinifolius, Artocarpus hirsuta* and *Swietenia macrophylla.*

150. Observations at the end of the first year showed a very slight increase in height growth in the burned gaps (significant in two out of three cases) and at the end of the second year also the same result was obtained (significant in one case out of three). In two cases out of the three the percentage of survivals was better in the burned gaps than in the unburned gaps.

151. Results are best seen in the table below—

Species.	Treatment.	Increase in mean height growth over unburned gaps. First year.	Second year.
		PER CENT.	PER CENT.
Acrocarpus fraxinifolius	Burn ..	14	17
Artocarpus hirsuta	Do. ..	10	10
Swietenia macrophylla	Do. ..	– 2	10

This beneficial effect of burning is contrary to the results obtained in artificial regeneration of evergreen species under evergreen shade and needs confirmation.

(For full experimental data see paragraph 291.)

152. *General.*—The general difficulties experienced in underplanting evergreens under evergreen shade have been found to be (1) generally low percentage survivals, (2) slow initial growth and (3) browsing. In studying the following results it must be remembered that Experimental Gardens are fenced and that browsing is not allowed to occur.

153. The general results obtained are—

(1) Transplanting is the best method to adopt for most species.

(2) Sowing gives poorer results than transplanting.

(3) Stumping is not a suitable method to use except in the case of two species *Artocarpus hirsuta* and *Cedrela toona.*

(4) Weeding is worth while as it gives a slight gain in initial growth and survival per cent.

(5) Pitting before planting is also worth while as although the beneficial effect is very small in the first year it becomes more prominent in the second year as the roots and their needs both get bigger.

154. It should also be noted that the two evergreen research centres have rather different climates, Chandanathode having a much heavier rainfall than Karian shola and most of the rain comes in the south-west monsoon whereas the latter centre gets a more evenly distributed precipitation.

155. *Direct sowing during monsoon months—Best date—Under top canopy only.*—In experiments 51 and 54, Chandanathode experimental garden and experiment 29, Karian shola experimental garden two species *Cedrela toona* and *Dysoxylum malabaricum* were experimented with. Seeds were sown at intervals of 15 days during August and September. Results as judged from survivals and height growth indicate that sowing in early July at Chandanathode and the second half of July at Karian shola are likely to be best. These however are only indications as in two of the three experiments survivals were very poor.

(For full experimental data see paragraph 292.)

156. *Transplanting throughout the year—Best date—Under full canopy but undergrowth removed.*—Seven experiments were done with this object with five species, transplanting being done once a month throughout the year. Results generally indicate the best time of transplanting as—

Karian shola ..	*Calophyllum elatum*	Mid June.
	Hopea parviflora	Mid July.
	Mesua ferrea	April-September (all dates about the same).
Chandanathode ..	*Artocarpus hirsuta*	June-August.
	Gluta travancorica	Do.
	Hopea parviflora	April-October. (August best but little difference in other months.)
	Mesua ferrea	June-August.

157. In general the time of best height growth coincided with the time of greatest survival percentage.

Karian shola experimental garden experiments 13, 14 and 15.

Chandanathode experimental garden experiments 27, 28, 29 and 31.

(For full experimental data see paragraph 293.)

158. *Entire transplanting—Monsoon months—Best date—Under top canopy only.*—In nine experiments with seven species transplanting was done on five dates from July 1st to September 30th.

Results generally indicate the best time of transplanting as :—

Karian shola ..	*Dipterocarpus bourdillonii* ..	Mid August.
	Hopea parviflora	Early August.
	Swietenia macrophylla	Do.
Chandanathode ..	*Cedrela toona*	All August and September (all dates about the same).
	Dysoxylum malabaricum ..	First half of September.
	Gluta travancorica	Early August.
	Hardwickia pinnata	Early September.
	Hopea parviflora	All August and September (all dates about the same).
	Swietenia macrophylla	Mid August to end of September.

These results should be read with those of the preceding paragraph.

Karian shola experimental garden experiments 25, 27 and 30.

Chandanathode Experimental Garden experiments 52, 55, 56 57, 58 and 62.

(For full experimental data see paragraph 294.)

159. *Stump planting—Best date* (*Top canopy only*).—Three experiments were done to find the best date of stump planting the two evergreen species for which the method is suitable. In one of these experiments (experiment 25 Chandanathode experimental garden) *Cedrela toona* was stump planted every two months from April to February and in the other two experiments (experiment 59 Chandanathode experimental garden and experiment 28 Karianshola experimental garden) *Cedrela toona* and *Artocarpus hirsuta* were stump planted on eight dates from the end of July to the end of September.

160. Results indicate the best seasons as :—

Chandanathode ..	*Artocarpus hirsuta*.	August to October.
	Cedrela toona ..	September.
Karian shola ..	*Artocarpus hirsuta*.	Mid August to mid September.

(For full experimental data see paragraphs 295 and 296.)

161. *Stump planting—Optimum diameter of stumps*.—Experiment 31 Karian shola Experimental Garden very definitely indicated that for *Artocarpus hirsuta* of 15 months old seedlings when stumped, the plants resulting from stumps of 0·4″—0·5″ diameter at the thickest part were greatly superior in percentage survivals and significantly better in mean height growth to stumps of 0·1″ to 0·2″ diameter at the end of the first hot weather.

(For full experimental data see paragraph 297.)

162. *Comparison of sowing, transplanting with large and small transplants and stumpimg with large and small stumps*.—Eighteen experiments were done to compare these various methods of raising evergreens under evergreen top canopy only. Seven species were experimented with and in all cases except one, transplanting was found to be the most successful method and in this case (experiment 46 Chandanathode experimental garden) with *Artocarpus hirsuta* transplanting gave nearly as good results as stumping.

163. With regard to the size of transplant to be used the following tentative conclusions are drawn as to the approximate size of transplant likely to do best when percentage of survivals and the increase,

decrease or maintenance of the initial difference in mean height growth between the large and small transplants are taken into consideration—

Artocarpus hirsuta	8″	These figures are the approximate middle of a range of size likely to be suitable to the species.
Cedrela toona	11″	
Dysoxylum malabaricum	12″	
Gluta travancorica	16″	
Hopea parviflora	10″	
Mesua ferrea	10″	
Swietenia macrophylla	6″	(In all cases the smaller transplants grow very much quicker than the larger transplants.)

(For full experimental data see paragraph 298.)

164. *Entire transplanting—Pits compared with crowbar holes.*—Ten experiments of the previous year were remeasured. In all cases the percentage of survivals after three years in three experiments and after two years in the remainder the results in pits were better than or about the same as those in crowbar holes. In mean height growth the superiority of plants grown in pits mentioned last year has become accentuated being from 2·77 per cent greater than that of plants in crowbar holes and significantly so in 8 out of 10 cases. It appears therefore that the extra expense of pitting for transplanting of evergreens is justified.

Chandanathode experimental garden experiments 1, 2, 3, 4, 35, 36, 38 and 39.

Karian shola experimental garden experiments 17 and 18.

(For full experimental data see paragraph 299.)

165. *Entire transplanting—Comparison of natural forest seedlings and nursery transplants.*—Three old experiments on this subject were remeasured and three new experiments done. The three species experimented with were *Hopea parviflora*, *Mesua ferrea* and *Palaquium ellipticum*. In these six experiments results are somewhat variable but show no marked superiority either in mean height growth or survival percentage for either of these two entirely two different kinds of transplants.

Karian shola experimental garden experiments 23 and 26.

Chandanathode experimental garden experiments 24, 34, 63 and 64.

(For full experimental data see paragraph 300.)

166. *Entire transplanting compared with basketing and mossing seedlings.*—In Chandanathode experimental garden experiment No. 60 and Karian shola experiment No. 3 *Dipterocarpus bourdillonii* was tried by the 3 methods of transplanting mentioned above. In the Chandanathode experiment basketing was not done properly

and the nil result should be discounted. At Karian shola however basketing proved a very successful method. No advantage was obtained at Chandanathode by mossing plants. The experiments need repetition.

(For full experimental data see paragraph 301.)

167. *Entire transplanting under full canopy—Effect of weeding.*—Four experiments of 1933 were remeasured (Chandanathode experimental garden experiments 42 and 43 and Karian shola Experimental garden experiments 21 and 22) in which half the transplants of *Mesua ferrea, Hopea parviflora* and *Swietenia macrophylla* had been left unweeded while the other half had normal weeding.

In May 1935 results showed that there was a slighly better survival per cent in the weeded lines. In mean height growth the weeded lines were significantly ahead of the unweeded lines to the extent of 3–10 per cent. This gain was significant in two cases out of the four experiments.

168. Although this gain is slight weeding is well worth while in evergreen forest where initial growth is so slow.

(For experimental data see paragraph 302.)

169. *Effect of burning in evergreen forests before artificial regeneration.*—Three experiments were done with four species, *Cedrela toona, Gluta travancorica, Hopea parviflora,* and *Swietenia macrophylla.* In all cases there was a very slightly better survival per cent in the burned lines but no difference at all in mean height growth between the two treatments.

Burning before artificial regeneration in evergreen forest appears to be neither beneficial nor harmful and is therefore not economically justified.

Chandanathode experimental garden experiments 32 and 33.

Karian shola experimental garden experiment 16.

170. *Effect of repulsive smears on browsing incidence.*—As browsing is such a serious menace to slow growing evergreen regeneration, an experiment was undertaken (Chandanathode experimental garden experiment 45) to see whether smearing the young plants with repulsives such as blood, neem oil and a mixture of the blood and the oil would reduce the browsing incidence. This experiment gave no effective results as the smeared plants and the controls were browsed to an equal extent. The blood smeared plants acted of course as congregation centres for leeches which appeared in their thousands but even this did not deter game.

(*xi*) Silvicultural Systems.—Nil.

(*xii*) Miscellaneous.

Spike Disease Research.

Introduction.

171. The investigation was carried out during the year under the directions of the District Forest Officer, Salem North, with the technical advice and general supervision of the Provincial Silviculturist.

A. Cause of spike.

172. (I) *Experiments to find out the carrier*—(i) *Cage experiments.*—(*a*) *Cloth cages at Javalagiri.*—In the six-acre regeneration plot at Javalagiri, 115 plants were caged, i.e., the aerial portions of the plants were covered with cloth in April 1932.

These have remained unspiked though 65 plants have died naturally, in the course of three years for want of light and air as the result of caging. Among the controls not caged, 13·7 per cent showed spike.

This result proves that (i) the infection takes place on the above ground portions of the plant, and (ii) that the carrier of infection is an agency operating above ground and it has been effectively prevented by the cloth screen.

173. (*b*) *Wire guaze cages.*—In March 1933, 14 plants were caged with wire guaze—4 of 10 meshes and 10 of 20 meshes to an inch at Noganur Reserved Forest with the object of confirming the results obtained in experiment I (i) (*a*) above but also to find out the size of the vector. In December 1933, the cages were supplemented by 8 more and during the year under report 20 new cages 10 of $\frac{5}{8}''$ meshes and 10 of $1''$ meshes were added. Thus we have at present 42 cages.

None of the caged plants have showed the disease so far whereas 19·0 per cent of the controls have become spiked. The bigger mesh cages are now for the first time passing through the active season of infection and it is too early to expect any results.

174. (ii) *Platform experiments.*—The object of these experiments are : (i) to confirm the results of Experiment No. (i) (*a*), i.e., if the carrier is one operating above ground, (ii) to indicate if insects are the probable vectors, (iii) to see if infection is greater at a height above the normal height of the bushes, (iv) if the bushes act as a screen for the plants kept inside and (v) to throw a light on the season of infection.

Since April 1931, batches of healthy sandal plants 21 for each set raised in the healthy locality of the Indian Institute of Science, Bangalore, have been brought and kept on platforms in the Aiyur Extension II Reserved Forest a very virulent spike area. The period of exposure was fixed from two to three months. The plants were

removed at the end of the period and kept either at the compound of the Indian Institute of Science or at Denkanikota Potculture both of which are healthy localities.

During the year, the period of exposure was reduced to one month (i.e., the plants are put on the platforms on the first day of every month and removed on the last day of the month) and the number of plants for each set was increased to 28.

The results obtained so far are tabulated below :—

Number of plants.		Period of exposure.	Number of plants spiked.	
On platforms.	On ground.		On platforms.	On the ground.
14	7	23rd April 1931 to 31st July 1931 ..	1	0
14	7	4th March 1932 to 6th May 1932 ..	2	0
14	7	6th October 1932 to 13th December 1932.	2	0
14	7	13th April 1933 to 11th June 1933 ..	1	0
14	7	13th August 1933 to 30th October 1933.	2	0
14	7	26th January 1934 to 28th March 1934.	1	0
14	14	1st August 1934 to 31st August 1934.	1	0
14	14	1st October 1934 to 31st October 1934	1	0

175. In the year 1934–35 the results so far obtained show that infection takes place in August and October. It is thus indicated (and by other results also) that the principal period of infection is April to June but there is also another infective period August to October.

Not only are the results of experiment (i) confirmed but a strong indication that insects are the probable vectors is also noted. The experiment is being continued in two localities.

176. (iii) *Experiments to determine the cause of potted plants being relatively resistant to infection.*—As the potted sandal plants were found to be apparently more resistant to spike than unpotted plants an experiment has been devised to test this observation. Three hundred plants have been raised with seeds collected from healthy trees of healthy localities. These have been transported to Javalagiri spike area where 100 plants have been buried with pots, 100 plants transplanted from the pots and 100 kept in pots on the ground. The experiment is randomised. Results are awaited.

177. *Two experiments to prevent attacks by insects or other similar agencies.*—As insects are usually attracted or repelled by smell or taste, it was decided to find out whether the carrier can be prevented from infecting the plant either by painting the stems with poisonous paints or covering it with a poisonous or strong smelling spray.

178. (*a*) *Painting with lead paint.*—(i) Hundred healthy sandal plants were selected in Noganur Reserved Forest in November 1933. Fifty were kept as controls and all stem portions of 50 were painted. Out of 50 painted plants four have shown the disease whereas 6/50 of the controls are spiked so far.

(ii) The experiment was repeated in two other localities—Javalagiri and Aiyur—during the year in the month of September 1934. At Javalagiri 1/50 of the painted ones and 2/50 of the controls and at Aiyur, 2/50 of the controls and none of the painted ones have shown the disease so far. It is too early to judge the results. It should be explained that it is of course impossible to apply the treatment to the smallest twigs, and these are thus left unprotected.

179. (*b*) *Spraying experiments*—(i) *Aiyur* (*Nyamasandiram area*).—This was started in August 1933. Three hundred sandal plants were selected in the manurial plot and sprayed with various chemicals. The results obtained are tabulated below :—

Nature of spray.	Number of plants sprayed.	Number spiked.
Lead arsenite	50	3
Copper arsenite	50	4
Asafoetida	50	3
Nicotine	50	6
Cinchona	50	4
Water for controls	50	10

(ii) The experiment has been repeated at Javalagiri where 108 plants have been taken for each treatment. The spraying was started in March 1935 and the following solutions were used : A. Copper arsenite, B. Lead arsenite, C. Cinchona, D. Nicotine—Nicotine, E. Controls—Water, F. Derrisol.

180. (3) *Transmission experiments in big cages*.—Though plenty of indirect evidence was obtained from the above silvicultural experiments indicating that insects are the probable vectors, yet the mass infection experiments and individual cage transmission experiments conducted by the Entomological Branch, Dehra Dun, for a period of 3½ years did not confirm the above results. As the work done by them was mainly on day collections, it was considered desirable to study night fauna intensively.

Accordingly two mass infection cages were erected, one at Denkanikota potculture area, a healthy locality, and another at Javalagiri a very virulently spiked area.

181. Insect fauna was collected between 9-30 p.m. and 5 a.m. and the insects so collected after taking out and mounting samples of different types, were counted and released in the mass infection cages.

At Denkanikota, the collections were done in Denkanikota Reserved Forest spike area and at Javalagiri, in the Javalagiri spike area itself.

It is to be noted that the Denkanikota area is not a virulently spiked one, and further, attempts to control the disease in this area have also been made with a fair amount of success. It is not unreasonable to assume that insects collected in this area will be on the whole less viruliferous than those collected at Javalagiri.

182. (i) *Javalagiri mass infection cage.*—The experiment was started here in August 1934 (19th August 1934) and 37 healthy plants with an approximately equal number of spiked plants were kept in the cage. Insect collection was started on 19th August 1934, and all insects collected during the night were released in the cage.

183. In December 1934, 23 additional healthy plants were placed inside the cage. On 30th January 1935, 1 plant No. 2162 became spiked. Material from this tree was grafted on 6 healthy plants, 2 of which have already (June 1935) developed virulent spike thus confirming the transmission. On 7th March 1935 and 9th March 1935 2 plants showed the disease and on this date, 15 plants among those placed in the cage on 19th August 1934, and 13 among those placed on 9th December 1934 were removed from the cage and transported to Denkanikota potculture plot after pruning their branches. Of these, five plants showed the disease in April 1935, whereas among those left in the cage 7 plants showed the disease. Thus 11 out of 22 that were in the cage and 5 out of 15 plants removed from the cage on 7th March 1935, showed the disease, all relating to plants kept in the cage from 19th August 1934 during a period of 5 to 9 months. None of the 10 plants kept in the cage from 9th December 1934 and none of the 13 plants removed from the cage on 7th March 1935 after exposing them to infection for nearly 3 months have shown the disease so far even though the period after exposure is 5 months.

184. The lower percentage of spike among the plants removed from the cage and defoliated (though with the small numbers involved the difference has little significance) may be due to (i) Decapitation of the twigs in which the virus possibly remained localized, (ii) continued infection and perhaps the increased dosage the plants that were inside the cage, got after 7th March 1935.

This proof of the transmission of spike by insects is one of the most important results of recent years.—From 10th March 1935, another set of plants has been kept exposed in the cage to detect another season of infection.

185. *Denkanikota mass infection cage.*—In Denkanikota cage, no infection has shown itself yet. The reason for this may be either the entire absence of certain types of insects or the presence of a few insects which perhaps died out under captivity when introduced into the cage or the insects lost their infective capacity by their transference to a healthy locality.

NOTE.—Since writing the above a case has been noticed in the Denkanikota cage on 6th July 1935. This has to be verified by grafting, but at present appears quite definite.

186. *Anyhow, the results obtained at Javalagiri indicate that insects are at least one of the carriers of spike infection.*

Representative collections were made both day and night for one week in the spiked areas of Javalagiri and Aiyur and non-spiked area of Kenilworth castle. By comparing these results

with the collections made for the mass infection cages both at Denkanikota and Javalagiri, 8 species of insects—3 belonging to Pentatomids, 2 of Jassids and 3 of Fulgorids have been selected for immediate transmission experimental work with individual species.

187. (*b*) The results indicated have been obtained as a result of introducing 265 types of insects caught at night. To find out which family is responsible for this transmission, a big cage with five compartments was constructed during the year at Javalagiri and the following groups are being let in, in each compartment separately: (1) Jassids, (2) Pentatomids, (3) Fulgorids and Coreids, (4) Locustids and (5) all other insects. Insect scars, etc., are being recorded and results are carefully studied.

188. *II. Detection of spike.*—Standing orders for the detection of new outbreaks of spike and its attempted control and eradication have been drawn up and submitted to the Chief Conservator of Forests for his approval and publication to all sandal districts.

Specimens of spiked and healthy sandal leaves have been preserved and are ready for despatch to other divisions where subordinates may be unfamiliar with the outward characteristics of the disease.

189. *New areas.*—During the year, two localities were found newly attacked in North Salem division in the previously healthy portions of Noganur Reserved Forest. Both are situated in the eastern half of Noganur Reserved Forest one about 1½ miles and the other about 1 mile as crow flies, from the infected locality. In one place, 12 spiked trees were found attacked in June 1934 and close to it, 17 trees were found spiked. These were girdled and treated with Atlas, and all apparently healthy trees in the area including those in a belt of 100 feet all round have been lopped to force out the disease if any.

In the other locality, only one solitary spiked tree was noticed, which was also girdled and treated with Atlas and all apparently healthy trees lopped.

190. *Results.*—In the first lopped area, 5 trees out of 3,170 trees lopped have shown the disease during the year and in the other where only one tree was found spiked, only 1 out of 62 lopped trees showed the disease.

In the big area, out of 3,170 trees lopped, 500 trees have been selected and sprayed with a composite spray of lead and copper arsenites with a view to prevent re-infection on new shoots. The remaining trees are kept as controls to the above.

191. *Old areas.*—In Denkanikota and Manchi spike areas where anti-spike measures have been taken since the beginning of 1933, the disease has been kept within its original limits whereas the spread in the uncontrolled areas of Guthiroyans is over five times the original extent.

The main object aimed at in these control operations in large areas is to minimize the sources of infection available for the vectors and thus to convert viruliferous vectors into non-viruliferous ones.

192. About 4 furlongs east of the Denkanikota area one solitary spiked tree was found in December 1934. This was treated as a separate centre, the tree was killed with arsenic solution and all healthy trees within a radius of 300 feet were lopped.

Months.	Denkanikota area.		Manchi area.		Guthiroyans.	
	Number of trees spiked.	Percentage of incidence.	Number of trees spiked.	Percentage of incidence.	Number of trees spiked.	Percentage of incidence.
June 1932 ..	..	..	62	0·7	..	..
July 1932 ..	..	..	58	0·7	..	..
August 1932 ..	..	..	151	1·8	..	..
September 1932 ..	..	..	212	2·5	..	..
October to November 1932.	..	..	22	0·3	..	..
December 1932 ..	..	..	173	2·1	..	..
January 1933 ..	11	0·1	49	0·6	..	..
February 1933 ..	77	0·8	77	0·9	..	..
March 1933 ..	123	1·2	22	0·3	..	..
April 1933 ..	..	..	342	4·0	..	..
May 1933	312	3·2	38	0·5	..	..
June 1933	254	2·7	..	..	..	..
July 1933	95	1·0	77	1·4	..	..
August 1933 ..	..	..	46	0·6	..	..
September 1933 ..	39	0·4	45	0·6	..	..
October to November 1933.	49	0·5	102	1·4	..	..
December 1933 to January 1934.	37	0·4	82	1·1	..	..
February to March 1934.	13	0·1	90	1·3	..	..
April 1934 ..	20	0·2	450	6·4	651	11·3
May to June 1934.	193	2·2	..	..	..	..
July 1934	97	1·1	188	2·9	..	..
August 1934 ..	32	0·4	..	..	189	3·7
September 1934 ..	48	0·6	99	1·6	..	..
October to November 1934.	52	0·5	..	..	..	..
December 1934 to January 1935.	193	1·9	121	1·9	..	..
February to March 1935.	90	0·9	..	..	..	..

NOTE.—Control operations were completed only in January 1933 in Denkanikota area and in April 1934 in Guthiroyana. The figures for the Guthiroyans area are not quite correct as the treatment itself was found defective.

193. In order to see whether lopping by itself renders the trees susceptible to the disease, an experiment was started in Noganur Reserved Forest. Two blocks each about 300 acres in extent representing the average type of the area were selected and all spiked trees in both the blocks were killed out with Atlas. In one block, all apparently healthy trees were lopped whereas in the other no lopping was carried out.

The results are—

Lopped block.			Unlopped block.		
Number of trees lopped.	Periodical incidence.		Total number of trees.	Periodical incidence.	
	Months.	Number spiked.		Months.	Number spiked.
6,525 ..	March-May 1933 ..	1,167	6,525 ..	March-May 1933 ..	815
	April-July 1933 ..	164		April-July 1933 ..	243
	August-September 1933.	80		August-September 1933.	247
	October-December 1933.	152		October-December 1933.	452
	January-February 1934.	89		January-February 1934.	655
	March-July 1934 ..	290		March-July 1934 ..	663
	Total ..	1,942		Total ..	3,075

194. The results indicate that spike infection is not increased in lopped areas due to devitalization of the trees by lopping.

The experiment is being repeated for confirmation.

195. *III. Morphological index of spike.*—Only two indications which require further confirmation have been obtained, viz., (i) Prolongation of the fruiting period, and (ii) Profuse flowering and fruiting.

196. *Grafting experiments.*—(i) The results of grafting done in four different localities to determine the influence of season on infection and manifestation are given below :—

Locality.	Season of grafting.	Number spiked / Number grafted.
Kenilworth castle area	May and June 1932	99/222
Do.	September and October 1932	8/43
Do.	May and June 1933	10/50
Thalli Reserved Forest healthy area	September and October 1932	4/25
Do.	May and June 1933	21/50
Thalli predisposed area	September and October 1932	11/25
Samayeri Reserved Forest area	Do.	4/50
Do.	May and June 1933	20/50
Pane Reserved Forest area	September and October 1932	1/50

One striking result in these areas is that though a certain number of trees which have shown the disease in 1934 (Kenilworth castle area —14, Thalli—21 and Samayeri—19) have remained in the area as disease masking trees since the date of grafting, no natural infection has occurred in the areas suggesting, that not only no viruliferous vectors have migrated into the area but none of the species of insects present in the area are the vectors. The other alternative is that the insects may have had no access to these disease masking trees.

(ii) *Grafting in Noganur area.*—This was started in December 1930 and carried on till December 1932, to find out (i) if the spiked tissue is virulent at all seasons of the year, (ii) the average and maximum incubation period and (iii) the relation between the dosage and the incubation period.

197. The results indicated that green tissues are infectious all through the year, and though the average period of incubation varied from 120 to 180 days in the field, the maximum incubation period went up to 1,172 days. For more or less the same aged plants, the period of incubation was found to be proportional to dosage.

Having got these results, the plot was taken up for control operations. All spiked plants were uprooted and burnt and all apparently healthy trees lopped. After pruning, 20 grafted plants and 36 ungrafted plants having root connexions with the grafted ones, showed the disease. These were removed and the area has remained free from spike since June 1934.

198. (*e*) *Ecological factors of the diseased areas.*—This has been dealt with in great detail in various bulletins and reports but a careful examination of the newly spiked areas confirmed the observations already recorded, viz. :—

(i) Proximity to cultivated fields,

(ii) intensive exploitation for fuel,

(iii) association of the intensive growth of lantana, and

(iv) the association of susceptible hosts such as *acacias*, *albizzias*, etc.

As a part of floristic surveys, study of the development of root system of host plants has been made in various areas by soil profile studies and results tabulated in bulletins previously issued.

199. (*d*) *Lantana in relation to spike.*—The effect of lantana on the incidence of spike has been discussed in detail in many previous papers. Ecological studies have revealed that lantana is fifteen times as abundant in spike areas as in a correspondingly healthy area and probably plays an important role in predisposing sandal areas to disease.

200. Continual weeding out of lantana brings down the incidence as detailed in the tabular statement below :—

Locality.	Lantana not cleared area.	Lantana cleared area.
	PER CENT.	PER CENT.
Cairn 53 area	64	35
Nyamasandiram area	79	40

Such continuous weeding also brings about a remarkable change in the floristic composition. The ecological change brought about by keeping down lantana in cairn 53 area at Javalagiri during the last ten years is a striking example. A comparative floristic survey of the two areas—lantana free and lantana infested, has revealed the presence of 57 species in lantana free area, and of these 21 are exclusive to the plot, being entirely absent from the lantana infested areas ; with regard to the common species occurring in both the plots, there is a decided preponderance of them in the lantana free plot which can easily be observed to be well stocked not only with sandal but also with host trees.

201. *IV. Control of spike*—(*a*) *Removal of sources of infection.*—The work done under this item has already been dealt with in paragraph 11 (old areas) under detection of spike.

202. (*b*) *Removal of predisposing factors*—(i) *Lantana eradication.*—This pest which was found in about 3,000 acres or 3 per cent of the extent of North Salem division in 1917 has now spread over 42 per cent of the area. Apart from its destructive nature on sandal and its associates detailed elsewhere, it has covered

up the grazing grounds and considerably reduced the grazing revenue. Its removal merely from the Silvicultural point of view is as important as the spike problem.

203. Hence it has been tackled by three methods, viz., (1) Biological, (2) Silvicultural and (3) Chemical.

For details see paragraphs 219 to 222 under weeds—lantana eradication.

204. *V. Isolation of resistant strains*—(i) *Autogenic resistance.*—(*a*) A certain number of sandal plants appear to possess autogenic resistance. Such plants resist artificial infection. During the course of grafting operations all the plants which resisted grafting thrice were isolated. Even defoliation after every infection did not bring out spike. Such plants amounting to 75 in number were taken to Javalagiri, a very virulent spike area and planted there, 25 in the Bungalow area and 50 in the manurial experimental plot on 23rd May 1932 and 13th July 1932. One of the plants in the Bungalow observation area and one in the manurial plot got the disease. The remainder are continuing healthy.

As controls to these, ten such plants were planted in Sanamavu Reserved Forest a healthy locality and all of them are continuing healthy. Seeds from such plants will be collected and plants raised.

More plants that have resisted grafting twice have been separated and kept for regrafting.

205. (*b*) During the course of examination to determine the morphological character of such apparently resistant plants and whether any identification can be made from the nature of seeds it was found that sandal seeds are differently venated with 3, 4, 5, 6 and multiple veins. Seeds of three venations are common. Seeds classified according to these venations were sown and seedlings obtained from seeds of four venations were found to have an elaborated root system and also a high haustorising capacity even from the very time of germination.

206. It was also found that plants possessing autogenic resistance have a bigger root system. To see whether there is any correlation between the resistant plant and four venated seeds, seedlings raised from seeds of different venation are being raised and artificial infection is being carried out by grafting.

(*c*) Seedlings obtained from seeds collected from healthy branches of spiked trees and exposed to natural infection at Javalagiri—all but two got the disease.

(*d*) Twelve plants obtained from seeds of healthy trees of old spike areas are also spiked.

207. (ii) *Acquired resistance.*—(*a*) The floristic surveys carried out in different localities indicated that healthy plants even in affected localities were always associated with certain types of species which were either exclusively present in the area or at least dominating. Plants of such species were grown in association with

sandal in pots under controlled conditions. Such sandal plants were tested by artificial infections. All plants associated with *Cassia siamea*, *Azadirachta indica*, *Murraya koenigii*, *Dodonea viscosa*, *Bambusa arundinacea*, *Erythroxylon monogynum*, *Ruta graveolens*, *Strychnos nux vomica*, *Zizyphus jujuba* gave a comparatively high amount of resistance whereas those associated with dhall, *acacias*, etc., got the disease easily.

208. For statistical working, the data was considered insufficient and 30 combinations of each species are being raised in pots for further tests under controlled conditions.

209. (*b*) (i). The above results were tested in the field. Instead of pots big mounds were erected and sandal raised with various host plants.

The results obtained confirm the potculture experiments except in the case of *Cassia siamea*, *Murraya koenigii*, *Dodonea viscosa*, *Zizyphus jujuba* which do not render sandal completely immune, but certainly impart a high amount of resistance. None of the combinations with *Azadirachta indica*, *Semecarpus anacardium*, *Erythroxylon monogynum* have so far got spike both under natural and artificial conditions. The experiment is being extended to other species of hosts.

210. (ii) Among the sandal plants raised with various species in isolated groups in the Javalagiri bungalow compound, the following combinations have got the disease :—

Lime (*Citrus medica acida*)	One spiked.
Plumaria acutifolia, *Poinciana regia* and dhall ..	Two spiked.
Pongamia glabra	Four spiked.
Artocarpus integrifolia, *Plumaria acutifolia* and dhall.	One spiked.
Melia dubia	Do.

211. (*c*) The results obtained from experiments 2 (*a*) and (*b*) are now being tested in small plantations. A block of four acres in Javalagiri Reserved Forest was selected and divided into four plots. In two diagonal plots, all species found to favour the disease not only from the grafting tests but also from floristic surveys were removed. The remaining hosts were supplemented with those found imparting resistance under potculture experiments and sandal introduced. In the other two diagonal plots resistance imparting hosts were removed and susceptible hosts and sandal introduced. The spike incidence up to end of September 1934 was found to be 6·1 per cent in the plot of susceptible hosts and 1·5 per cent in the plots in which resistant hosts were introduced.

The results are tabulated below :—

Plot A—	Resistant hosts—	16	spiked.
,, C—	Do.	2	,,
,, B—	Non-resistant—	9	,,
,, D—	Do.	—48	,,

or Plots A and C ; B and D ; 18/400 : 57/400 or = 1 : 3·2.

212. (*d*) Two plots each about 10 acres in extent were opened in 1929–30, one at Nyamasandiram Agraharam Reserved Forest and the other at Javalagiri for manurial treatment. These plots are kept under observation to note the incidence of spike in order to deduce the value of manures introduced.

As the plot at Nyamasandiram is fully stocked with hosts especially *Zizyphus*, it is kept as it is, whereas at Javalagiri the proportion of hosts was poor. Hence the plot has been divided into six sections of which two are being stocked with resistive hosts, two with susceptive hosts and two with all hosts after removing lantana. In these plots of resistant hosts, sandal plants possessing autogenic resistance have been introduced. Further, the plot is well stocked with sandal and all plants are watched to isolate the resistant strain, and also to work out the morphological index for disease masking trees.

213. (*e*) *Fuel exploitation area at Noganur.*—The object is to see if exploitation of fuel, timber, etc., in a sandal area would bring in spike disease on sandal. The plot was opened in September 1931. No spike has yet come into the area. The ill effects of coppicing hosts intensively parasitized by sandal are well illustrated.

214. (*f*) *Six-acre regeneration area—Javalagiri.*—In this area, one plot about one-fourth of an acre in extent well stocked with a single species of hosts—*Melia dubia* has been isolated by trenching. Thirteen plants of sandal have been established and of these one is spiked. The plot is being stocked with more sandal.

The other plots are being stocked with susceptible hosts with the idea of isolating a resistant strain from the existing stock of sandal.

215. (*g*) *Curative and preventive treatments.*—The results obtained by introducing rarer elements such as iron, copper, etc., are not so far very encouraging.

216. *Summary.*—The following are the outstanding results of spike investigation during the year :—

(i) *Insects especially the night fauna form one of the carriers of spike infection.*

(ii) The removal of the sources of infection (spiked and disease masking trees) reduces the amount of spike infection considerably. The spread in spike controlled areas is nil whereas in the uncontrolled ones, is five times the original extent.

(iii) Lopping by itself does not render the trees more susceptible to spike infection.

(iv) Resistance to varying extent is built up in sandal associated with various hosts. No case of infection out of nine *Azadirachta indica*, three *Strychnos nux vomica*, three *Semecarpus anacardium*, three *Erythroxylon monogynum* combinations on mounds in the Javalagiri area and none out of 25 combinations of the above species in pots has taken

place, and only 2/15 of *Cassia siemea*, 1/4 of *Zizyphus jujuba* have been spiked so far. *It is to be noted that hosts imparting resistance generally contain a bitter or oily principle.*

(v) Plants can be saved from spike infection by caging either with cloth or wire guaze of ten or more meshes to an inch.

(vi) Plants possessing autogenic resistance appear to resist even natural infection. Only 2/75 which resisted artificial infection three times have got the disease from natural infection.

(vii) Potted plants appear to be more resistant to spike infection than unpotted plants.

(viii) Fuel exploitation in sandal areas does not appear to bring in the disease immediately but hosts intensively parasitized by sandal when coppiced either die or give rise to feeble coppice shoots. Sandal plants feeding on such hosts do not thrive well.

217. *Periodicity of height growth—General.*—Measurements were taken weekly at all centres with a number of species to determine the active growing periods and resting periods of the young trees.

Results so far show the following :—

Experimental garden.	Rest period.	Species.
Topslip	20th November 1934 to 20th February 1935.	Teak, *Dalbergia latifolia*, *Xylia xylocarpa*.
Begur	7th November 1934 to 15th April 1935.	Teak, *Dalbergia latifolia*, *Terminalia crenulata*, *Xylia xylocarpa* *Swietenia macrophylla*, *Pterocarpus marsupium*.
Dhoni	All species grew steadily without a rest period.	Teak, *Dalbergia latifolia*, *Pterocarpus marsupium*, *Xylia xylocarpa*.
Kannoth	Do.	Teak, *Dalbergia latifolia*, *Pterocarpus marsupium*, *Artocarpus hirsuta*.
	1st January 1935 to 30th April 1935.	*Swietenia macrophylla*.

218. *All-India Teak Seed Origin Plots, Nilambur.*—In Experimental Plot 129 all origins grew in the same way steadily right through without a rest period. In Experimental Plot 123 all origins grew steadily from 8th June 1934 to 20th December 1934 and then rested until 25th June 1935 when they again started to grow. Although growth started and stopped on roughly the same dates for all origins yet the growth curves of Nilambur, Anamalais and Travancore origins (i.e., South India orgins) are similar to each other but different from the growth curves of South Bombay and North and South Burma which are all similar to each other.

219. *Weeds—Lantana eradication.*—(i) *Silvicultural methods.*—An experiment in North Salem Division was started in September 1933 to see whether *Bambusa arundinacea* (which had been noticed

to come up through dense lantana) would suppress this pest. In 1933 the bamboo was introduced by sowing seed in worked patches under the lantana. In 1934 one-year old seedlings were introduced to replace casualties. At the end of the 1935 hot weather 90 per cent are surviving and are up to 1′ 6″ in height averaging 8″. The seedlings are very healthy and show promise.

220. The introduction of species such as *Cassia siamea* and *Azadirachta indica* in cleared gaps 20′ × 20′ has also been started in North Salem Division. *Cassia siamea* looks promising but of course it is too early to say whether it will successfully compete with the lantana.

It should be noted that in these lantana areas the density of lantana is about 10,000 stems to the acre.

221. (ii) *Entomological methods.*—An attempt at the control of lantana by an insect *Orthesia insignis* (Dougl) which looked promising has been given up on the advice of the Forest Entomologist, Forest Research Institute, Dehra Dun.

222. (iii) *Chemical methods.*—(*a*) Spraying with sodium chlorate caused lantana to die off but in the second season some of the plants produced shoots from the base. These shoots have been re-sprayed apparently successfully but it is too early to be definite.

(*b*) In one acre of lantana each stem was girdled and treated with Atlas solution. This was completely successful but cost Rs. 13–11–0.

In both these chemical experiments it should be noted that in the second year a few new plants arise from seed which was dormant in the soil, so that treatment for at least two years is necessary.

223. *Climber eradication by poisoning.*—Three experiments were done with *Zizyphus oenoplia* (Experimental Plot 10, Chittoor Division), *Acacia intsia* (Experimental Plot 137, South Coimbatore Division) and *Pterolobium indicum* (Experimental Plot 14, North Coimbatore Division). The poison was a solution of sodium arsenite made up by boiling one part of arsenious oxide with three parts of sodium carbonate (by weight) in water and diluting the solution to the following three strengths :—

A. Strong 1 lb. AS_2O_3 in $\frac{3}{4}$th gallon of solution.

B. Medium 1 lb. AS_2O_3 in 3 gallons of solution.

C. Weak 1 lb. AS_2O_3 in 12 gallons of solution.

224. The poison was applied in two ways namely scraping off the bark near ground level and painting on the solution and making a frill all round the stem and pouring the solution into it. Of the two methods scraping was found easier to do, more economical in solution and quite as effective as frilling. The application of the poison was done in January 1934 for the *Zizyphus* experiment, March 1934 in the *Acacia intsia* experiment, and March 1935 in the *Pterolobium* experiment.

225. Results in March and April 1935 are shown in the following table :—

Species.	Number of creepers treated.	Method of application.	Strength of poison.	Date of application.	Apparently dead.	With green or partly green stem.	Producing shoots from ground level.	Remarks.
Zizyphus œnoplia (Experimental Plot No. 10, Chittoor Division).	10	Stem scraped	Strong	January 1934	10	..	..	Results by March 1935.
	10		Medium		7	..	..	
	10		Weak		4	..	6	
	10	Stem frilled	Strong	..	8	..	2	
	10		Medium	..	10	..	..	
	10		Weak	..	7	..	3	
Acacia intsia (Experimental Plot 137, South Coimbatore Division).	20	Stem scraped	Strong	March 1934	16	4	..	
	20		Medium		12	8	..	
	20		Weak		5	15	..	
	19	Stem frilled	Strong	..	14	5	..	
	20		Medium	..	7	13	..	
	20		Weak	..	7	13	..	
Pterolobium indicum (Experimental Plot 14, Coimbatore North Division).	10	Stem scraped	Strong	March 1935	10	..	..	Results by April 1935.
	10		Medium		6	4	..	
	10		Weak		2	8	..	
	10	Stem frilled	Strong	..	10	..	..	
	10		Medium	..	5	5	..	
	10		Weak	..	3	7	..	

The cost of the operations and poison per 100 climbers treated is approximately 11 annas, 3 annas, and 1 anna for the strong, medium, and weak solutions respectively.

226. From the results it appears that the strong solution is effective and the medium solution fairly effective while the weak solution is not effective. It is probable that the best solution economically will be a solution intermediate in strength between the strong and the medium.

It is worthy of note that in the *Zizyphus* experiment some climbers (especially those treated with the medium solution) produced shoots from the base while in the *Acacia intsia* experiment this did not occur. The fate of these shoots during the hot weather is to be observed. In the *Pterolobium* experiment there has not yet been time enough for these shoots to appear.

227. *Euphorbia antiquorum eradication.*—Two experiments were carried out to see whether this *Euphorbia* which is very common in fuel coupes could be easily killed by girdling (Experimental Plots 12 and 13, North Coimbatore Division). In each experiment the treatment was applied in September 1934 and by March 1935. Of these 40 trees 36 were completely dead and the remaining 4 were nearly dead and dying fast. In the course of this experiment, it was found that it is cheaper and quicker to fell the tree than to girdle it, as for girdling the coolies have to come into much closer contact with the milky juice which is injurious to the eyes.

228. *Euphorbia tirucalli.*—In a similar experiment in Chittoor Division (Miscellaneous experiment No. 20) 20 trees of *Euphorbia tirucalli* were girdled in February 1934. By March 1935 all trees were dead and fallen except one which was dead but not fallen. Here again it was found quicker and cheaper to fell the *Euphorbia* than to girdle it.

229. *Attempted suppression of Eupatorium on the Nilgiris.*—Kikiyu grass has been introduced in a series of plots in the Nilgiris to see whether it will compete with *Eupatorium*. Up to the present the grass has established itself and is growing vigorously and the struggle is commencing. Results are awaited.

230. *Grass suppression in fuel coupes.*—In the blanks which occur in many dry fuel forests a short but rank growth of grass occurs which is often a serious hindrance to regeneration operations. In Experiment No. 9 Emmanur Experimental Garden *Leucœna glauca* seed was broadcast in prepared patches in such a grassy blank to see whether it would be of any use as a weed suppressor. Although initial germination was good and showed promise all the seedlings died out during the abnormal hot weather. The experiment is being repeated.

II. WORKING PLANS AND STATISTICS.

(*i*) Working Plans.

231. The Provincial Silviculturist continued to be in touch through the Conservator of Forests, Working Plans Circle, with the Working Plans Officers in the various districts.

He was largely consulted with regard to proposed prescriptions on silvicultural matters and statistical work. The experience gained and the results obtained in this branch were availed of by Working Plans Officers and District Forest Officers.

232. The following statement shows the working plans under preparation in the Working Plans Circle, at the beginning of the year under review, those completed during the year, and the new ones undertaken :—

Number.	Working Plans under preparation at the beginning of the year.	Working Plans completed during the year.	New Working Plans commenced during the year.
I	East and West Vellore Division.	..	..
II	Tinnevelly Division ..	Tinnevelly Division ..	North and South Cuddapah Divisions.
III	Madura Division ..	..	..
IV	Salem North Division.	Salem North Division.	The Nilgiri Division.
V	Coimbatore South Division.	Coimbatore South Division.	Upper Godavari Division.

233. The following working plans submitted to the Chief Conservator of Forests were sanctioned during the year :—

(1) Working Plan for Coimbatore North Division.

(2) Working Plan for the Godavari Lower Division.

(3) Working Plan for the Kollegal Division.

(4) Working Plan for the Coimbatore South Division (except Mount Stuart previously completed and sanctioned).

The Working Plan for the Tinnevelly Division is pending sanction.

234. The cost of preparation of the following completed working plans inclusive of establishment are as below :—

No. II Working Plan Division, Tinnevelly, As. 3–5 per acre.

No. IV Working Plan Division, Salem North, As. 3–4 per acre.

No. V Working Plan Division, Coimbatore South, As. 3–9 per acre.

(*ii*) Yield, Volume and Form Factor Tables.

235. *Sample plots.*—One hundred and two sample plots were maintained. Two sample plots at Nilambur and one on the Nilgiris were due for remeasurement.

This work is pending receipt of new type of extensible ladder from Dehra Dun best suited for accurate height measurement of standing trees.

236. The collection of data for local commercial volume tables of eight important species occurring in the natural forest at Nilambur was completed during the year and the tables are under final compilation in this division.

237. The tree increment plots referred to in previous report were maintained. Improved methods of crown classification drawn up in consultation with the Central Silviculturist have not yet been adopted and the plots are pending reclassification.

(*iii*) Bark Measurements.

Heartwood measurements.—Nil.

III. MISCELLANEOUS.

Tours and Records.

238. *Tours.*—The Provincial Silviculturist was only able to spend the bare minimum number of days on tour. He was forced to spend a great deal of time at headquarters doing computing of figures and compilation of results owing to lack of staff.

239. The following notes and articles were prepared during the year :—

(*a*) Article to the Indian Forester on " Stump planting of teak in Madras,"

(*b*) " Note on Mahogany and its future possibilities," and

(*c*) " Note on exotic forest species in Madras with special reference to Eucalypts."

240. The Silviculturist attended the All-India Silvicultural Conference held at Dehra Dun from 29th October to 3rd November 1934.

241. Opportunity was taken while touring in the Wynaad Research centre to visit the research experiments conducted in Coorg in accordance with the orders of the Government to co-operate with the Chief Forest Officer, Coorg, in the conduct of such experiments.

242. *Records.*—The specific and general ledger files now number 418 and 143, respectively. The subdivision of the more bulky files and the condensation and publication of information referred to in last year's report has not been attended to yet for want of time and lack of staff.

243. Ten new experimental plots were opened during the year. The number of experimental garden experiments started or in progress during the year was 292.

244. Two hundred and thirty-three photographs have been added to the collection during the year of which 3 were taken by the Central Silviculturist, 226 by the Provincial Silviculturist, 4 by the Conservator of Forests, Working Plans Circle.

Staff.

245. The extra Assistant Conservator of Forests posted as Assistant to the Silviculturist remained throughout the year in the division.

The subordinate staff now consists of three rangers, eight foresters and one forest guard. The office staff of one clerk and one typist was increased by the sanction of one more clerk but still the staff has proved totally inadequate to cope with the existing work in the office.

A. L. GRIFFITH,
Silviculturist.

Ootacamund,
20*th August* 1935.

PART II.

246. *Rainfall in inches and number of rainy days per month (vide paragraph 3)*—

—	April 1934.	May 1934.	June 1934.	July 1934.	August 1934.	September 1934.	October 1934.	November 1934.	December 1934.	January 1935.	February 1935.	March 1935.	April 1935.	May 1935.	June 1935.	or year 1st April 1934 to 1st April 1935.	Average of years.	
Evergreen Forests.																		
Topslip, Karianshola	2·60/2	2·60/3	17·9/17	5·80/7	5·35/6	..	10·75/10	2·40/3	..	1·80/3	0·40/1	..	2·86/4	..	5·70/12	33·49/52	62·2	13
Chandanathode	0·10/1	4·10/2	52·10/23	53·10/28	55·10/29	10·40/18	16·20/14	4·50/4	..	..	..	0·20/1	5·30/6	2·10/4	22·20/22	205·30/120	153·3/144	20
Mixed Deciduous Forest.																		
Nilambur	1·81/5	2·11/9	31·81/25	18·08/25	12·17/22	1·26/8	11·85/20	1·70/5	..	0·82/1	..	–	2·08/6	3·07/6	15·70/21	81·61/98	112·5/112	62
Begur	2·68/7	4·12/9	10·09/23	10·33/27	10·93/26	1·68/9	6·29/15	1·56/6	..	1·35/2	..	0·39/1	4·38/16	1·71/8	4·16/20	49·42/125	72·98/74	20
Kannoth	..	..	..	..	..	..	..	..	..	..	..	..	..	2·14/7	24·51/25	..	73·31/137	18
Dhoni	4·56/2	3·28/9	34·31/24	20·69/24	16·36/19	1·74/8	11·48/19	2·84/6	..	..	..	..	5·93/8	2·54/2	11·86/23	92·26/99	106·39	9
Walayar	0·60/1	2·00/4	6·60/15	12·80/11	5·40/8	..	5·40/9	0·40/1	0·20/1	..	..	..	1·00/2	..	1·50/6	33·40/50	53·55	17
Dry Fuel Forests.																		
Satyamangalam	1·43/3	3·43/8	1·37/4	0·64/4	1·46/4	–	8·80/16	5·49/7	..	0·14/2	0·25/1	..	4·06/12	1·19/4	1·61/3	23·01/49	29·86/55	43
Denkanikota	1·54/3	4·68/11	1·83/8	1·36/8	0·33/5	0·54/3	9·09/15	2·95/6	0·03/1	0·14/2	0·25/1	..	4·06/2	1·19/4	1·61/3	22·74/63	33·49/70	14

247. *Seed weighments (vide paragraph 21)*—

Serial number and species.	Month in which to collect seed.	Number. Seeds. Per oz.	Number. Seeds. Per lb.	Number. Fruits. Per oz.	Number. Fruits. Per lb.	Weighments.	Plant per cent.	Germinative capacity per cent.	Number of tests.	Number of seeds or fruits tested.	Plant per lb. Seed or fruit.
1 Acacia auriculiformis	III–IV	1,222	..	..	..	3	59	67	10	2,900	11,420
2 Acacia cyanophylla	VI	2,010	..	..	..	5	93	94	12	4,300	29,750
3 Acacia ferruginea	III	2,688	..	..	..	2	80	90	2	4,000	34,200
4 Acacia leucophlœa	III–IV	1,284	..	..	..	3	28	28	4	1,000	5,320
5 Acacia sundra	II–V	761	..	..	..	3	90	90	15	4,900	12,120
6 Acrocarpus fraxinifolius	III–IV	320	..	..	..	2	21	22	25	13,000	1,075
7 Albizzia amara	II–IV	383	..	..	..	5	74	79	14	5,200	4,509
8 Anacardium occidentale	III–V	..	102	..	..	4	98	98	12	3,580	100
9 Artocarpus hirsuta	VI	42	..	..	..	14	74	80	31	8,140	496
10 Azadirachta indica	III–IV	184	..	..	..	2	2	3	4	800	*59
11 Bambusa arundinacea	IV	2,912	..	..	..	2	37	38	5	1,500	17,200
12 Calophyllum elatum	VI	..	69	..	..	13	8	9	8	1,600	6
13 Cassia fistula	III–V	185	..	..	..	4	26	36	11	3,200	753
14 Cassia marginata	II–V	144	..	..	..	4	47	65	10	3,000	1,080
15 Cassia siamea	III–IV	1,060	..	..	..	4	87	98	11	3,200	14,750
16 Cedrela toona	V	7,150	..	..	..	2	62	82	17	1,690	70,900
17 Chloroxylon swietenia	III–VI	3,395	..	..	..	6	64	69	16	20,800	34,100
Do.	III–VI	1,325	..	..	..	14	21	23	14	21,000	† 4,450
18 Dalbergia latifolia	I–III	601	..	..	..	3	49	64·5	28	23,500	4,710
19 Dendrocalamus strictus	IV	865	..	..	..	4	47	48	5	1,500	6,490
20 Dipterocarpus bourdillonii	V	..	78	..	..	6	20	41	6	3,000	16
21 Dysoxylum malabaricum	VII–VIII	..	55	..	..	1	85	85	29	1,435	47
22 Erythroxylon monogynum	I–II	1,018	..	..	..	1	2	2	2	800	326
23 Gluta travancorica	V	..	28	..	..	1	60	60	26	4,455	17
24 Gmelina arborea	V–VI	42	..	..	..	1	56	64	25	8,500	376
25 Hardwickia pinnata	..	..	74	..	..	1	80	85	5	500	59
26 Hopea parviflora	V–VII	‡70	..	..	..	11	54	68	36	74,000	625
27 Lagerstrœmia lanceolata	III	319	..	..	..	2	5	10	16	56,000	254
28 Palaquium ellipticum	VII–VIII	..	185	..	..	2	36	36	16	1,050	67
29 Pithecolobium dulce	IV	189	..	..	..	2	23	46	8	800	695
30 Prosopis juliflora	Not known	1,005	..	..	..	5	78	89	9	3,000	12,230
31 Prosopis spicigera	III–IV	157	..	..	..	2	88	88	7	2,400	2,211
32 Pterocarpus dalbergioides	III	59	..	..	..	2	19	23	11	2,400	§179
33 Pterocarpus marsupium	II–IV	55	..	..	..	4	90	97	30	2,700	789
34 Pterocarpus santalinus	II–IV	..	458	..	..	6	47	58	13	4,000	215
35 Santalum album	X	‖140	..	..	..	14	39	47	6	500	874
36 Swietenia macrophylla	III	54	..	..	..	7	32	32	15	1,800	276
37 Tectona grandis	II–III	47	..	..	..	14	58	62	20	26,000	432
38 Terminalia chebula	XI–II	¶362	..	..	..	5	50	60	16	4,020	¶2,880
39 Terminalia crenulata	III–IV	13	..	..	..	6	58	72	45	25,800	121
40 Terminalia paniculata	III–IV	738	..	..	..	7	2	2	14	10,300	234
41 Xylia xylocarpa	I–III	107	..	..	..	2	79	99	34	19,400	13,580

NOTE.—For germinative capacity and plant per cent the maxima obtained are given.

* Seeds badly eaten by rats in these tests. † Seed from Ceylon. ‡ With wings. § Seed from the Andamans.
‖ With pulp; without pulp weight is 195 seeds per ounce. ¶ Kerned.

248. *Sorting seed according to size—Teak* (*vide paragraph* 22)—*Experiment No.* 60—*Topslip Experimental Garden.—Arrangement*—A B C D D C B A. repeated five times in single lines of 10 patches, i.e., 50 patches per treatment. *Espacement*—6′ × 3′. *Soil preparation*—Patches 1′ diameter and 6″ deep at each stake. *Stock used*—

A. District sample random, average 0·6″ diameter, 500 seed weighed 12 ounces.
B. Selected biggest seed, average 0·7″ diameter, 500 seed, weighed 20 ounces.
C. Selected medium seed, average 0·6″ diameter, 500 seed weighed 15 ounces.
D. Selected small seed, average 0·5″ diameter, 500 seed weighed 10 ounces.

Date of sowing—Fifteen seed per patch sown on 29th April 1934. *Treatment*—Normal district weeding.

Experiment No. 51—*Dhoni Experimental Garden.—Arrangement, etc.*, as above. *Stock used*—

A. District sample random, average 0·5″ diameter, 1,000 seed weighed 21 oz.
B. Selected biggest seed, average 0·65″ diameter, 1,000 seed weighed 22 oz.
C. Selected medium seed, average 0·56″ diameter, 1,000 seed weighed 20 oz.
D. Selected smallest seed, average 0·40″ diameter, 1,000 seed weighed 13 oz.

Date of sowing—Fifteen seed per patch sown on 19th April 1934.

Experiment No. 25—*Begur Experimental Garden—Arrangement, etc.*, as above. *Stock used*—

A. District sample random, average 0·5″ diameter, 53 seeds per ounce.
B. Selected biggest seed, average 0·7″ diameter, 30 seeds per ounce.
C. Selected medium seed, average 0·5″ diameter, 42 seeds per ounce.
D. Selected smallest seed, average 0·3″ diameter, 98 seeds per ounce.

Date of sowing.—Fifteen seeds per patch sown on 30th April 1934.

Data after one season's growth.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height growth in inches.	Difference from control.	Significance.
Dhoni Experimental Garden 51.	District sample.	7th February 1935.	88	5·43 ± 0·28	Control.	
	Selected biggest.	Do.	96	6·08 ± 0·37	+ 0·65 ± 0·47	N.S.
	Medium ..	Do.	92	0·67 ± 0·30	+ 0·64 ± 0·41	N.S.
	Smallest ..	Do.	92	5·17 ± 0·32	— 0·26 ± 0·43	N.S.

Data after one season's growth—cont.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height growth in inches.	Difference from control.	Significance.
Topslip Experimental Garden 60.	District sample.	1st February 1935.	80	10·35 ± 0·63	Control.	
	Selected biggest.	Do.	86	10·42 ± 0·60	+0·07 ± 0·87	N.S.
	Medium ..	Do.	94	11·53 ± 0·57	+1·18 ± 0·84	N.S.
	Smallest ..	Do.	90	11·71 ± 0·61	+1·36 ± 0·88	N.S.
Begur Experimental Garden 25.	District sample.	22nd December 1934.	80	7·32 ± 0·36	Control.	
	Selected biggest.	Do.	39	9·36 ± 0·96	+2·04 ± 1·08	N.S.
	Medium ..	Do.	65	8·16 ± 0·48	+1·84 ± 0·60	N.S.
	Smallest ..	Do.	61	8·04 ± 0·60	+0·72 ± 0·72	N.S.

249. *Size, age and condition of seed bearers—Teak.*—(*vide paragraph* 24)—

Experiment 65—*Topslip Experimental Garden.*—*Arrangement*—A B C C B A. repeated 10 times in single lines of 10 patches 10 seeds dibbled per patch. *Espacement* 6′ × 6′. *Soil preparation.*—Worked patches 1′ diameter and 6″ deep at each stake. *Stock used*—Seed collected from—

(A) Very old healthy trees (10′ 6″ and 10′ 9″ girth).
(B) Healthy trees (4′ 5″ and 5′ 3″ girth).
(C) Immature healthy trees (2′ 7″, 2′ 9″ and 2′ 5″ girth).

Date of sowing—30th April 1934. *Treatment*—Normal district weeding.

Experiment No. 26-*A*—*Begur Experimental Garden.*—*Arrangement, etc.*, as above. *Stock used*—Seed collected from—

(A) Trees 7′ 5″ and 4′ 11″ girth.
(B) Tree 3′ 0″ girth.
(C) Tree 12′ 10″ girth.

Date of sowing—30th April 1934. *Treatment as above.*

Experiment No. 50—*Dhoni Experimental Garden.*—*Arrangement, etc.*, as above. *Stock used*—Seed collected from—

A. Trees 4′ 5″ and 5′ 3″ girth.
B. Trees 2′ 7″, 2′ 10″ and 2′ 5″ girth.
C. Trees 10′ 9″ and 10′ 6″ girth.

Date of sowing.—19th April 1934. *Treatment* as above.

Data after one season's growth.

Experiment.	Girth of seed bearer.	Date of measurement.	Survival per cent.	Mean height inches.	Difference from control.	Significance.
Top slip Experimental Garden 65.	A 10′ 6″ 10′ 9″	2nd February 1935.	34	5·75 ± 0·41	+0·03 ± 0·47	N.S.
	B 4′ 5″ 5′ 3″	Do.	38	5·72 ± 0·23	Control.	
	C 2′ 7″ 2′ 9″ 2′ 5″	Do.	51	5·52 ± 0·25	— 0·20 ± 0·34	N.S.
Begur Experimental Garden 26 (*a*).	A 7′ 5″ 4′ 11″	15th February 1935.	83	7·08 ± 0·36	Control.	
	B 3′ 0″	Do.	78	5·52 ± 0·24	— 1·56 ± 0·48	S.
	C 12′ 10″	Do.	69	6·60 ± 0·36	— 0·48 ± 0·48	N. S.

Data after one season's growth—cont.

Experiment.	Girth of seed bearer.	Date of measurement.	Survival, per cent.	Mean height in inches.	Difference from control.	Significance.
Dhoni experimental garden 50.	A 4′ 5″ 5′ 3″	6th February 1935.	79	8·58 ± 0·42	Control.	
Do.	B 2′ 7″ 2′ 10″ 2′ 5″	Do.	81	7·68 ± 0·36	— 0·90 ± 0·55	N.S.
Do.	C 10′ 9″ 10′ 6″	Do.	81	7·85 ± 0·35	— 0·73 ± 0·54	N.S.

250. *Size, age and condition of seed bearers—Dalbergia latifolia (vide paragraph* 25)—

Experiment No. 57—*Topslip Experimental Garden.—Arrangement*—A B C C B A. repeated 10 times in single lines of 10 plants, 10 broken pods were dibbled at each stake. *Espacement*—6′ × 3′. *Soil preparation*—Worked patches 1′ diameter 6″ deep at each stake. *Stock used*—Seed collected from—

A. Very old healthy trees, 10′ 6″ to 10′ 9″ girth.
B. Healthy trees, 4′ 3″ to 4′ 5″ girth.
C. Immature healthy trees, 2′ 9″ 2′ 11″ girth.

Date of sowing—29th April 1934. *Treatment*—Normal district weeding.

Experiment No. 26-*B*—*Begur Experimental Garden.—Arrangement, etc.*—As above. *Stock used*—Seed collected from—

A. Trees, 5′ 7″ girth.
B. Trees, 2′ 9″ girth.
C. Trees, 12′ 8″ girth (an old hollow tree).

Remainder as above.

Experiment No. 47—*Dhoni Experimental Garden.—Arrangement, etc.*—As above. *Stock used*—Seed collected from—

A. Trees, 4′ 3″ 4′ 5″ girth.
B. Trees, 2′ 11″ 2′ 9″ girth.
C. Trees, 10′ 6″ 10′ 9″ girth.

Date of sowing—19th April 1934. *Treatment*—As above.

Data after one season's growth.

Experiment.	Girth of seed bearer.	Date of measurement.	Survival, per cent.	Mean height in inches.	Difference from control.	Significance
Top slip experimental garden 57.	A 10′ 6″ 10′ 9″	1st February 1935.	75	7·33 ± 0·34	— 0·28 ÷ 0·50	N.S.
	B 4′ 3″ 4′ 5″	Do.	77	7·61 ± 0·36	Control.	
	C 2′ 9″ 2′ 11″	Do.	74	8·03 ± 0·37	+0·42 ± 0·51	N.S.
Begur experimental garden 26 B.	A 5′ 7″	28th December 1934.	67	4·20 ± 1·80	Control.	
	B 2′ 9″ ..	Do.	56	4·44 ± 1·68	+ 0·24 ± 0·24	N.S.
	C 12′ 8″ ..	Do	58	4·20 ± 2·16	+ 0·24 ± 0·24	N.S.
Dhoni experimental garden 47.	A 4′ 3″ 4′ 5″	5th February 1935.	48	9·63 ± 0·69	Control.	
	B 2′ 11″ 2′ 9″	Do.	57	9·40 ± 0·47	— 0·23 ± 0·83	N.S.
	C 10′ 6″ 10′ 9″	Do.	52	11·58 ± 0·76	+ 1·95 ± 1·02	N.S

251. *Size, age and condition of seed bearers—Terminalia crenulata (vide paragraph* 26)—

Experiment 48—*Dhoni Experimental Garden.*—

Arrangement—ABCCBA. repeated 10 times in single lines of 10 plants—*Espacement*—6′ × 3′. *Soil preparation*—Worked patches 1′ diameter 6″ deep at each stake. *Stock used*—Seed collected from—

A. Trees, 4′ 6″ 5′ 3″ girth.

B. Trees, 2′ in girth.

C. Trees, 8′ 3″ 8′ 6 ″ girth.

Date of sowing—19th April 1934. *Treatment.*—Normal district weeding.

Experiment 56—*Topslip Experimental Garden—Arrangement, etc.*—As above. *Stock used*—Seed collected from—

A. Trees, 11′ 2 ″ 8′ 10″ girth.

B. Trees, 4′ 10″ 5′ 4″ girth.

C. Trees, 2′ 11 ″ 2′ 7″ girth.

Date of sowing.—29th April 1934. *Treatment.*—As above.

Experiment 26-*C*—*Begur Experimental Garden.*—*Arrangement, etc.*—As above. *Espacement*—6′ × 6′. *Stock used*—Seed collected from—

A. Trees 5′ 8″ girth.
B. Trees 2′ 10″, 1′ 7″ girth.
C. Trees 8′ 4″ girth.

Date of sowing—30th April 1934. *Treatment*—As above.

Data after one season's growth.

Experiment.	Girth of seed bearers.	Date of measurement.	Survival, per cent.	Mean height in inches.	Difference from control.	Significance.
Dhoni experimental garden 48.	A 4′ 6″ 5′ 3″	6th February 1935.	78	5·13 ± 0·19	Control.	..
	B 2′ 0″	Do.	79	5·38 ± 0·23	+ 0·25 ± 0·30	N.S.
	C 8′ 3″ 8′ 6″	Do.	79	5·11 ± 0·21	− 0·02 ± 0·29	N.S.
Topslip experimental garden 56.	A 11′ 2″ 8′ 10″	1st February 1935.	25	23·56 ± 1·55	+ 1·14 ± 2·26	N.S.
	B 4′ 10″ 5′ 4″	Do.	26	22·42 ± 1·64	Control.	..
	C 2′ 11″ 2′ 7″	Do.	16	24·63 ± 1·25	+ 2·21 ± 2·06	N.S.
Begur experimental garden 26.	A 5′ 8″	22nd December 1934.	31	15·00 ± 1·32	Control.	..
	B 2′ 10″	Do.	55	13·28 ± 0·96	− 1·72 ± 1·68	N.S.
	C 8′ 4″	Do.	11	13·68 ± 1·92	− 1·32 ± 2·40	N.S.

252. *All India teak seed origin plots*—(*vide paragrpah* 27).

Experimental Plot No. 123—*Nilambur division.*—Arrangement in single lines of forty plants of each origin arranged A.B.C.D.E.F., A.B.C.D.E.F., etc., repeated six times, i.e.,

240 plants of each origin. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes. *Stock used*—Stumps of the following sizes from nursery beds sown in 1933 :—

Nilambur	0·4″ to 0·5″	Root 6 inches to 9 inches in length, stumps in most cases poorly developed ; plants were all less than 10 inches in height in the nursery.
Mount Stuart	0·4″ to 0·5″	
Travancore	0·4″ to 0·5″	
South Bombay ..	0·2″ to 0·3″	
South Burma	0·3″ to 0·4″	
North Burma	0·3″ to 0·4″	

Date of planting.—20th July 1933.

Experimental Plot No. 129—*Nilambur Division.—Arrangement*—The area of 10·2 acres were divided into 24 sub-plots approximately equal and each 0·43 acres in extent and the six origins Nilambur, Anamalais, Travancore, South Bombay and North and South Burma distributed among them randomized in a way with 4 replications of each origin. *Espacement.*—6′ × 6′. *Soil preparation.*—Crowbar holes. *Stock used.*—Stumps of the following sizes from 1933 nurse beds :—

Origin.	Diameter at thickest part.	Remarks.
Nilambur	0·3″ to 0·8″	Root 6″–9″ in length, shoot 1″–2″.
Anamalais	0·3″ to 0·6″	
Travancore	0·3″ to 0·8″	
South Bombay	0·3″ to 0·4″ (with 10 per cent under 0·3″).	
South Burma	0·4″ to 0·9″	
North Burma	0·4″ to 0·9″	

Date of stump planting.—9/12th May 1934.

Experimental Plot No. 138—*South Coimbatore Division.—Arrangement*—The area of 4 acres was divided into 16 quarter-acre plots and allotted to origins in the order

D.C.B.A.A.B.C.D.

A.B.C.D.D.C.B.A.

A—South Burma.
B—Anamalai.
C—Mysore.
D—Nilambur.

Espacement—6′ × 6′. *Soil preparation.*—Crowbar holes. *Stock used.*—Stumps of the following sizes from 1933 nursery beds :—

Origin.	Diameter at thickest part.
South Burma	0·3″ – 0·8″
Anamalai	0·3″ – 0·8″
Mysore	0·3″ – 0·7″
Nilambur	0·3″ – 0·8″

Date of stump planting—14/17th April 1934.

Origin.	Experimental Plot No. 107—Nilambur, 1931–1935 measurements.				Experimental Plot No. 123 Nilambur, 1933–1935 measurements.	
	Survival, per cent.	Mean height in feet.	Difference of means.	Significance.	Survival, per cent.	Mean height in feet.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Nilambur ..	95	17·42 ± 0·18	Control.	..	98	10·6 ± 0·13
Anamalais ..	..	..	..	..	96	10·2 ± 0·18
Walayar ..	79	13·80 ± 0·27	−3·62 ± 0·33	S	..	..
Travancore ..	94	15·60 ± 0·28	−1·82 ± 0·34	S	97	9·8 ± 0·20
South Bombay.	88	16·43 ± 0·32	−0·99 ± 0·37	S	89	10·1 ± 0·16
South Burma.	43	12·20 ± 0·39	−5·22 ± 0·43	S	97	8·6 ± 0·21
North Burma.	36	14·88 ± 0·55	−2·54 ± 0·58	S	92	8·3 ± 0·20

Origin.	Experimental Plot No. 123—Nilambur, 1933–35 measurements—*cont.* Difference means.	Signifi-cance.	Experimental Plot No. 129—Nilambur, 1934–1935 measurements. Survival, per cent.	Mean height in feet.	Difference of means.	Signifi-cance.
	(8)	(9)	(10)	(11)	(12)	(13)
Nilambur ..	Control.	..	100	4·32 ± 0·04	Control.	
Anamalais ..	−0·4 ± 0·22	N.S.	100	5·29 ± 0·05	+ 0·97 ± 0·06	S
Walayar ..	..	..	..	..	..	..
Travancore ..	−0·8 ± 0·24	S	100	4·33 ± 0·05	+ 0·01 ± 0·06	N.S.
South Bombay.	−0·5 ± 0·20	S	100	5·69 ± 0·08	+ 1·37 ± 0·09	S
South Burma.	−2·0 ± 0·25	S	100	4·20 ± 0·06	− 0·12 ± 0·07	N.S.
North Burma.	−2·3 ± 0·23	S	100	3·44 ± 0·04	− 0·88 ± 0·06	S

253. *Nursery Shading Experiment.*—(*vide paragraph* 32)—

Locality—*Emmanur Experimental Garden.*—*Climate*—Hot and dry from March to June. Rainfall 30 inches, mostly between July and December. *Arrangement*—Shaded and open nursery beds adjoning each other.

Type of shade—Bamboo mats 4′-5′ above the ground. *Treatment*—Seed-beds watered once per day in dry weather.

Species.	Date of sowing.	Number tests.	Number of seed used for shade and open tests separately.	Germinative capacity. Open.	Shade.
(1)	(2)	(3)	(4)	(5)	(6)
Acacia auriculiformis ..	8th August 1934.	2	100	25	67
Acacia cyanophylla	Do.	2	200	4	56
Acacia ferruginea	Do.	2	100	65	90
Acacia leucophlœa	Do.	2	100	30	38
Acacia sundra	Do.	2	200	9	26
Anacardium occidentale ..	Do.	2	200	19	88
Cassia fistula	Do.	2	200	11	26
Cassia marginata	Do.	2	200	11	27
Chloroxylon swietenia ..	Do.	2	100	16	32
Prosopis juliflora	Do.	2	200	56	53
Pterocarpus santalinus ..	Do.	2	200	7	10
Santalum album	Do.	2	100	8	72
Terminalia chebula	Do.	2	100	38	7

Species.	Plant per cent by the following June. Open.	Shade.	Heights of seedlings by following February in inches. Open.	Shade.	Remarks.
	(7)	(8)	(9)	(10)	(11)
Acacia auriculiformis ..	15	56	3½	5	Seed immersed in boiling water and allowed to cool.
Ccacia cyanophylla	2	8	¾	2	Do.
Acacia ferruginea	59	80	9½	11	No pre-treatment.
Pcacia leucophloea	20	20	3	3	Seed immersed in boiling water and allowe d to cool.
Acacia sundra	3	14	4½	5	No pre-treatment.
Anacardium occidentale ..	14	59	9¾	11	Do.
Cassia fistula	6	12	2½	3½	Do.
Cassia marginata	3	18	2	5½	Do.
Chloroxylon swietenia ..	9	24	2	4½	Do.
Prosopis juliflora	42	44	11	11½	Do.
Pterocarpus santalinus ..	3	5	2¾	3	Seed soaked in cold water for 24 hours.
Santalum album	0	0	0	0 *	
Terminalia chebula	30	3	2¾	3¾ †	

* Sown after removing pulp.

† Sown after fleshy coat removed,

254. *Nursery methods for raising teak stumps* (vide *paragraph* 36)—

Experiment No. 32—*Begur Experimental Garden.—Arrangement.*—40 lines of 10 plants arranged A.B.C.D., A.B.C.D (i.e., 100 of each treatment). *Espacement*—6′ × 3′. *Soil preparation.*—Crowbar holes. *Stock used*—1 year stumps, A and B 0·3″—0·5″ diamater, average 0·38″. C 0·2″—0·5″ diameter, average 0·31.″ D 0·2″—0·6″—average 0·39.″

Date of stump planting—19th May 1934. *Tending*—Normal district weeding.*Treatments.*—Stumps made from 1 year plants resulting from the following nursery treatments :—

A. Nursery beds sown thickly·seeds almost touching.

B. Seedllngs pricked into nursery beds 4″ × 4″.

C. Germinating seeds from dumps notched 4″ × 4″.

D. Soaked seed dibbled 3″ × 1½″.

Data after one season's growth.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Begur Experimental Garden 32.	A	22nd December 1934.	92	12·60 ± 0·60	Control.	..
	B		88	12·84 ± 0·60	+ 0·24 ± 0·84	N.S.
	C		82	12·48 ± 0 60	− 0·12 ± 0·84	N.S.
	D		93	12·24 ± 0·60	− 0·36 ± 0·84	N.S.

255. *Effect of intensity of burning before regenerating gaps in mixed deciduous forest*—(*vide paragraph* 42)—

Experimental Plot No. 15—*Wynad division—Arrangement*—Twenty four gaps of as nearly as possible the same size and close together in a portion of mixed deciduous forest of fairly even quality were allotted to treatments in the order A.B.C., A.B.C. *Piling of brushwood*—In a square 25 feet each way brushwood was piled as follows :—

A. gaps.—Piles 3 feet high, larger logs at bottom, smaller at top. Many logs up to 30 inches girth included.

B. gaps.—The square of 25 feet each way in the centre of each gap was scraped clean of weeds.

C. gaps.—Piles 2 feet high of small branches up to 14 inches girth and bamboos.

Burning—A and C gaps were burnt on 18th and 20th March 1933. A gaps took more than a day to burn, C gaps took three to four hours. *Soil preparation*—At 16 stakes 6′ × 6′ espacement in the middle of the burnt or cleared portion of each gap crowbar holes were made. *Stock used*—Teak stumps from nurseries sown 11 months previously using local seed. Size of stumps was 0·3″ to 0·4″ at collum 0·6″—0·7″ at thickest part, with 9″ root and 1″ shoot.

Number of plants—One hundred and twenty-eight of each treatment. *Date of planting*—5th May 1933.

The average diameters of the gaps in the canopy were A. 53 feet, B. 50 feet, C. 50 feet. The average height of the surrounding forest was A. 76 feet B. 84 feet, C. 79 feet, so that the mean solid angles of light subtended at the centres of the gaps were A. 39 degrees, B. 33 degrees, C. 35 degrees.

Species—Teak.
District—Wynad, Experimental Plot No. 15.
Year of formation—1933.

Treatment.	February 1934 measurements.				March 1935 measurements.			
	Survival per cent.	Mean height in feet.	Difference of means.	Significance.	Survival per cent.	Mean height in feet.	Difference of means.	Significance.
Severe burn ..	80	0·66±0·03	+0·09±0·03	S	80	2·22±0·14	+0·49±0·16	S
No burn ..	88	0·58±0·03	Control.	..	88	1·73±0·13	Control.	..
Light burn ..	95	0·67±0·03	+0·10±0·03	S	95	2·62±0·17	+0·89±0·19	S

256. *Comparison of direct sowing entire transplanting and stump planting—Teak* (*vide paragraph* 43)—

Experiment No. 23-*A*—*Begur Experimental Garden.*—*Arrangement*—ABCCBA repeated 10 times in lines of 10 plants i.e., 100 plants per treatment. *Espacement*—6′×6′. *Soil preparation*—Direct sowing in patches 15″ diameter and 4″ deep, transplanting in 1′ cube pits, stump planting in crowbar holes. *Stock used*—Sowing 12 seeds per patch. *Transplants*—Three months old, 4″ high. *Stumps*—One year old 0·3″—0·4″ diameter. *Date of sowing*—30th April 1934. *Transplanting*—24th July 1934. *Stump planting*—19th May 1934. *Treatment*—Normal plantation weeding.

Experiment No. 64—*Topslip Experimental Garden.*—*Arrangement, etc.*—As above. *Stock used*—Sowing 10 seeds per patch. *Transplants*—Three months old 3″ high. *Stumps*—One year old 0·4″—0·8″ diameter. *Date of sowing*—27th April 1934. *Transplanting*—7th July 1934. *Stump planting*—27th April 1934.

Experiment No. 56—*Experimental Garden, Dhoni.*—*Arrangements, etc.*—As above. *Stock used*—Sowing 15 seeds per patch. *Transplants*—Three months old 3″—4″ high. *Stumps*—One year old 0·3″—0·7″ diameter. *Date of sowing*—19th April 1934. *Transplanting*—5th May 1934. *Stump planting*—19th April 1934.

Data after one season's growth.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Begur—Experimental Garden No. 23-A.	Direct sowing..	13th February 1935.	56	4·32±0·36	—2·88±0·60	S.
	Transplanting.	Do.	66	4·32±0·24	—2·88±0·48	S.
	Stump-planting.	Do.	93	7·20±0·48	Control.	

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Topslip—Experimental Garden No. 64.	Direct sowing..	5th February 1935.	54	8·37 ± 0·56	—16·20 ± 1·35	S.
	Transplanting.	Do.	30	8·00 ± 0·69	—16·57 ± 1·41	S.
	Stump-planting.	Do.	79	24·57 ± 1·23	Control.	
Dhoni—Experimental Garden No. 56.	Direct sowing..	1st February 1935.	63	7·84 ± 0·34	—7·87 ± 0·77	S.
	Transplanting.	Do.	77	6·30 ± 0·32	—9·39 ± 0·76	S.
	Stump-planting.	Do.	94	15·71 ± 0·69	Control.	

257. *Comparison of direct sowing entire transplanting and stump-planting*—(vide paragraph 44)—*Dalbergia latifolia*—

Experiment No. 46—*Dhoni Experimental Garden.*—*Arrangement.*—A.B.C.C.B.A. repeated 10 times in single lines of 10 plants (i.e., 100 plants per treatment). *Espacement*—6′ × 3′. *Soil preparation*—*Sowing*—patches 1′ diameter and 6″ deep, *transplanting* 1′ cube pits, *Stump planting*—crowbar holes. *Stock used*—*Sowing*—15 pods per patch ; *Transplants* 6 weeks old 2″–3″ high. *Stumps*—One year old 0·1″/0·2″ diameter. *Date of sowing*—18th April 1934. *Transplanting*—24th June 1934. *Stump planting*—18th April 1934. *Treatment*—Normal district weeding.

Experiment No. 49—*Topslip Experimental Garden.*—*Arrangement, etc.*—as above. *Stock used*—*Sowing* 15 broken pods per patch. *Transplants*—Two months old and 3″ high. *Stumps* one year old 0·1″–0·2″ diameter. *Date of sowing*—25th April 1934. *Transplanting*—7th July 1934. *Stump planting*—25th April 1934.

Experiment No. 23-*B*—*Begur Experimental Garden.*—*Arrangement, etc.*—As above. *Stock used*—*Sowing*—About 45 seed in crushed pods per patch, *transplants* three months old and 6″ high. *Stumps*—One year old 0·1″–0·2″ high. *Date of sowing*—30th April 1934. *Transplanting*—24th July 1934. *Stump-planting*—19th May 1934.

Data after one season's growth.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Dhoni—Experimental Garden No. 46.	Sowing ..	5th February 1935.	68	10·66 ± 0·71	Control.	
	Transplanting.	Do.	45	9·90 ± 0·91	—0·76 ± 1·15	N.S.
	Stump-planting.	Do.	84	19·57 ± 0·98	+ 8·91 ± 1·21	S.
Topslip—Experimental Garden No. 49.	Sowing ..	31st January 1935.	75	9·84 ± 0·51	Control.	
	Transplanting.	Do.	46	5·52 ± 0·33	—4·32 ± 0·60	S.
	Stump-planting.	Do.	75	18·41 ± 0·84	+ 8·57 ± 0·98	S.
Begur—Experimental Garden No. 23-B.	Sowing ..	22nd December 1934.	63	5·52 ± 0·36	Control.	
	Transplanting.	Do.	8	3·36 ± 0·72	—2·16 ± 0·72	S.
	Stump-planting.	Do.	83	7·08 ± 0·36	+ 1·56 ± 0·48	S.

258. *Comparison of direct sowing, entire transplanting and stump planting* (*vide paragraph* 45)—*Pterocarpus marsupium*—

Experiment No. 58—*Topslip Experimental Garden*—*Arrangement.*—A.B.C.C.B.A. repeated 10 times in single lines of 10 plants (i.e., 100 plants per treatment). *Espacement*—

6′×3′. *Soil preparation—Sowing* patches 1′ diameter 6″ deep. *Transplanting* 1′ cube pits. *Stump planting*—Crowbar holes. *Stock used*—Sowing 10 seeds per patch. *Transplants*—Two months old 5″ high. *Stumps*—One year old 0·3″—0·4″ diameter. *Date of sowing*—25th April 1934. *Transplanting*—7th July 1934. *Stump planting*—25th April 1934. *Treatment*—Normal district weeding.

Experiment No. 38—*Dhoni Experimental Garden.—Arrangements, etc.* as above. *Stock used*—Sowing 15 seeds per patch. *Transplants*—One month old 2″—3″ high. *Stumps*—One year old 0·3″–0·4″ diameter. *Date of sowing*—18th April 1934. *Transplanting*—24th June 1934. *Stump planting*—18th April 1934.

Experiment No. 23 *D—Begur Experimental Garden.—Arrangement, etc.* as above. *Stock used—Sowing* 10 seeds per patch. *Transplants*—Three months old 4½″ high. *Stumps*—One year old 0·3″—0·4″ diameter. *Date of sowing*—30th April 1934. *Transplanting*—24th July 1934. *Stump planting*—19th May 1934.

Data after one season's growth—Pterocarpus marsupium.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Topslip—Experimental Garden No. 58.	Sowing ..	1st February 1935.	28	6·64±0·28	Control.	
	Transplanting.	Do.	91	7·25±0·27	+0·61±0·39	N.S.
	Stump planting.	Do.	87	10·67±0·52	+4·03±0·59	S.
Dhoni—Experimental Garden No. 38.	Sowing ..	5th February 1935.	96	16·66±0·98	Control.	
	Transplanting.	Do.	88	8·97±0·43	—7·69±1·07	S.
	Stump planting.	Do.	86	24·57±1·39	+7·91±1·70	S.
Begur—Experimental Garden No. 23-D.	Sowing ..	21st December 1934.	80	7·08±0·36	Control.	
	Transplanting.	Do.	67	5·32±0·24	—1·76±0·36	S.
	Stump planting.	Do.	96	13·20±0·60	+6·12±0·72	S.

259. *Comparison of direct sowing, entire transplanting and stump planting* (*vide paragraph* 46)—*Terminalia crenulata*—

Experiment No. 45—*Dhoni Experimental Garden—Arrangement.*—ABCCBA repeated 10 times in single lines of 10 plants (i.e., 100 plants of each treatment). *Espacement*—6′×3′. *Soil preparation—Sowing*—Patches 1′ diameter and 6″ deep. *Transplanting*—1′ cube pits. *Stump planting*—Crowbar holes. *Stock used—Sowing*—15 seeds per patch. *Transplants* one month old 3″–4″ high. *Stumps* one year old 0·3″–0·7″ diameter. *Date of sowing*—18th May 1934. *Transplanting*—24th June 1934. *Stump planting*—18th April 1934. *Treatment*—Normal district weeding.

Experiment No. 50—*Topslip Experimental Garden.—Arrangements, etc.* as above. *Stock used—Sowing*—10 seeds per patch. *Transplants*—Two months old 4″ high. *Stumps*—

One year old 0·5″–0·9″ diameter. *Date of sowing*—25th April 1934. *Transplanting*—27th June 1934. *Stump planting*—25th April 1934.

Experiment No. 23-*C—Begur Experimental Garden.—Arrangement, etc.* as above. *Stock used—Sowing*—10 seeds per patch. *Transplants*—Three months old 7″ high. *Stumps* one year old 0·5″–0·6″ diameter. *Date of sowing*—30th April 1934. *Transplanting*—24th July 1934. *Stump planting*—19th May 1934.

Data after one season's growth.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height inches.	Difference from control.	Significance.
Dhoni—Experimental Garden No. 45.	Sowing ..	5th February 1935.	75	16·45±0·81	Control.	
	Transplanting.	Do.	77	16·18±0·98	—0·27±1·27	N.S.
	Stump planting.	Do.	91	29·58±1·43	+13·40±1·64	S.
Topslip—Experimental Garden No. 50.	Sowing ..	1st February 1935.	23	23·56±1·22	Control.	
	Transplanting.	Do.	41	14·63±1·00	—8·93±1·58	S
	Stump planting.	Do.	77	33·12±1·57	+9·56±1·99	S.
Begur—Experimental Garden No. 23-C.	Sowing ..	22nd December 1934.	11	9·12±1·08	Control.	
	Transplanting.	Do.	49	8·16±0·48	—0·96±1·20	N.S.
	Stump planting.	Do.	90	19·08±0·72	+9·96±1·32	S.

260. *Comparison of direct sowing, entire transplanting and stump planting* (*vide paragraph* 47)—*Xylia xylocarpa*—

Experiment No. 44—*Dhoni Experimental Garden.—Arrangement*—ABCCBA repeated 10 times in single lines of 10 plants (i.e., 100 plants per treatment). *Espacement*—6′×3′. *Soil preparation—Sowing* patches 1′ diameter 6″ deep. *Transplanting* 1′ cube pits. *Stump planting* crowbar holes. *Stock used—Sowing* 15 seeds per patch. *Transplants*—One month old 2″-3″ high. *Stumps*—One year old 0·1″–0·2″ diameter. *Date of sowing*—18th April 1934. *Transplanting*—24th June 1934. *Stump planting*—18th April 1934. *Treatment*—Weeding as in a district plantation.

Experiment No. 51—*Topslip Experimental Garden.—Arrangements, etc.*, as above. *Stock used—Sowing*—10 seeds per pitch. *Transplants*—Six weeks old 4″ high. *Stumps*—One year old 0·2″–0·3″ diameter. *Date of sowing*—25th April 1934. *Transplanting*—7th July 1934. *Stump planting*—25th April 1934.

Experiment No. 23-*E—Begur Experimental Garden.—Arrangements, etc.*—as above. *Stock used—Sowing*—12 seeds per patch. *Transplants*—two months old 3″ high. *Stumps*—One year old 0·1″–0·2″ diameter. *Date of sowing*—8th May 1934. *Transplanting*—24th July 1934. *Stump planting*—19th May 1934.

Data after one season's growth.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Dhoni—Experimental Garden No. 44.	Sowing ..	5th February 1934.	74	10·05±0·42	Control.	
	Transplanting.	Do.	40	6·80±0·41	—3·25±0·59	S.
	Stump planting.	Do.	60	5·63±0·41	—4·42±0·58	S.
Topslip—Experimental Garden No. 51.	Sowing ..	1st February 9135.	59	5·93±0·31	Control.	
	Transplanting.	Do.	5	3·00±0·25	—2·93±0·40	S.
	Stump planting.	Do.	33	3·61±0·16	—2·32±0·33	S.
Begur—Experimental Garden No. 23-E.	Sowing ..	22nd December 1934.	82	3·84±0·12	Control.	
	Transplanting.	Do.	3	2·76±0·48	—1·08±0·48	S.
	Stump planting.	Do.	67	3·00±0·12	—0·84±0·24	S.

261. *Comparison of direct sowing, entire transplanting and stump planting—Swietenia macrophylla—(vide paragraph* 48)—

Experiment No. 23 *F.—Begur Experimental Garden—Arrangement.*—ABCCBA repeated 10 times in single lines of 10 plants (i.e. 100 plants per treatment). *Espacement*—6′ × 6′ *Soil preparation—Sowing*—Patches 15″ diameter 4″ deep. *Transplanting* 1′ cube pits. *Stump planting*—Crowbar holes. *Stock used—Sowing*—6 seeds per patch. *Transplants* three months transplants $6\frac{1}{2}''$ high. *Stumps* one year old 0·3″–0·4″ diameter. *Date of sowing*—30th April 1934. *Transplanting*—24th July 1934. *Stump planting*—25th May 1934. *Treatment*—Normal district weeding.

Experiment No. 5 *B—Kannoth Experimental Garden.—Arrangement, etc.* as above. *Stock used—Sowing*—10 seed per patch. *Transplants* 1 year old 10″— 12″ high. *Stumps*—one year old 0·2″—0·4″ diameter. *Date of sowing*—22nd May 1934. *Transplanting*—1st July 1934. *Stump planting*—28th May 1934.

NOTE—This experiment was done in a ponam crop of hill paddy.

Data after one season's growth.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height inches.	Difference from control.	Significance.
Begur—Experimental Garden 25 F.	Sowing ..	22nd December 1934.	51	9·00±0·48	Control.	
	Transplanting.	Do.	71	9·24±0·36	+0·24±0·60	N.S.
	Stump planting.	Do.	11	5·04±0·46	—3·96±0·60	S.
Kannoth—Experimental garden 5 B.	Sowing ..	7th January 1935.	24	13·20±0·72	Control.	
	Transplanting.	Do.	55	13·56±0·48	+0·36±1·80	N.S.
	Stump planting.	Do.	4	5·00±1·80	—7·20±1·92	S,

262. *Comparison of direct sowing, entire transplanting and stump planting—*

Artocarpus hirsuta—(vide paragraph 49).—

Experiment No. 5 *A. Kannoth Experimental Garden—Arrangement.*—ABC CBA repeated 10 times in single lines of 10 plants (i.e., 100 plants per treatment). *Espacement*—6′ × 3′. *Soil preparation.—Sowing*—patches 1′ diameter 6″ deep. *Transplanting*—1′ cube pits. *Stump planting*—Crowbar holes. *Stock used—Sowing* 10—15 seeds per patch. *Transplants*—One year old 9″–14″ high. *Stumps*—One year old 0·3″—0·5″ diameter. *Date of sowing*—22nd May 1934. *Transplanting*—7th August 1933. *Stump planting*—29th May 1934. *Treatment*—Normal district weeding.

NOTE—This experiment was done in a ponam crop of hill paddy.

Data after one season's growth.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Kannoth—Experimental garden 5 A.	Sowing ..	24th April 1935.	12	11·16±1·56	Control.	
	Transplanting.	Do.	2	12·00±3·00	+0·84±3·36	N.S.
	Stump planting.	Do.	33	14·88±1·56	+3·72±2·16	N.S.

263. *Premonsoon stump planting—Teak—(vide paragraph* 52)—

Experiment No. 1—*Walayar Experimental Garden—Arrangement*—ABCDE EDCBA repeated 10 times in single lines of 10 plants (i.e., 100 plants of each date).—*Espacement* 6′ × 6′. *Soil preparation*—Crowbar holes. *Stock used*—Stumps from one year transplants. *Date of stump planting*—Fortnightly from 5th April 1934 to 2nd June 1934.

Experiment No. 42—*Dhoni Experimental Garden.—Arrangement, etc.* as above. *Espacement*—2′ × 2′. *Stock used*—One year stumps 0·3″—0·5″ diameter. *Date of stump planting*—Fortnightly from 16th March 1934 to 1st June 1934.

Experiment No. 22—*Begur Experimental Garden Arrangement, etc.,* as above. *Espacement*—6′ × 6′. *Stock-used*—One year stumps 0·3″–0·5″ diameter. *Date of stump planting*—15th March 1934, 31st March 1934, 16th April 1934.

Experiment No. 45—*Top slip Experimental Garden—Arrangement etc..* as above. *Espacement*—3′ × 3′. *Stock used*—One year stumps 0·3′—0·7″ diameter. *Date of stump planting*—Fortnightly from 16th March 1934 to 1st June 1934.

Experiment I (a)—Kannoth Experimental Garden—Arrangement etc., as above. *Espacement*—6′ × 6′. *Stock used*—One year stumps 0·4″—0·7″ diameter. *Date of stump planting*—Fortnightly from 2nd April 1934 to 15th June 1934.

NOTE—This experiment was done in a ponam crop of hill paddy sown in the last fortnight of May 1934.

Growth data.

Experiment.	Treatment. Date of planting.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Walayar—Experimental garden 1.	A 5th April 1934.	14th February 1935.	83	16·61±0·90	+5·38±0·98	S.
	B 17th April 1934.	Do.	80	13·34±0·68	+2·11±0·78	S.
	C 2nd May 1934.	Do.	86	16·13±0·78	+4·90±0·87	S.
	D 17th May 1934.	Do.	95	11·92±0·42	+0·69±0·57	N.S.
	E 2nd June 1934.	Do.	94	11·23±0·38	Control.	
Dhoni—Experimental garden 42.	A 16th March 1934.	5th February 1935.	10	15·00±2·42	+4·42±2·46	N.S.
	B 1st April 1934.	Do.	54	18·80±1·40	+8·22±1·47	S.
	C 16th April 1934.	Do.	97	17·78±1·09	+7·20±1·17	S.
	D 1st May 1934.	Do.	90	9·32±0·40	—1·26±0·59	S.
	E 16th May 1934.	Do.	93	11·29±0·54	+0·71±0·70	N.S.
	F 1st June 1934.	Do.	95	10·58±0·44	Control.	
Begur—Experimental garden 22.	A 15th March 1934.	15th February 1935.	12	10·20±2·64	0·00±2·64	N.S.
	B 31st March 1934.	Do.	22	11·04±1·44	0·84±1·56	N.S.
	C 16th April 1934.	Do.	92	10·20±0·48	Control.	
Top slip—Experimental garden 45.	A 16th March 1934.	31st January 1935.	71	34·3+1·97	+15·82±2·09	S.
	B 1st April 1934.	Do.	97	29·5±1·85	+11·0±1·98	S.
	C 16th April 1934.	Do.	96	36·6±1·98	+18·1±2·10	S.
	D 1st May 1934.	Do.	95	30·0±1·51	+11·5±1·67	S.
	E 16th May 1934.	Do.	89	18·6±1·12	+0·1±1·32	N.S.
	F 1st June 1934.	Do.	96	18·5±0·70	Control	
Kannoth—Experimental garden 1 (*a*).	A 2nd April 1934.	7th January 1935.	37	11·88±0·96	+5·40±0·96	S.
	B 15th April 1934.	Do.	75	16·68±8·64	+10·20±0·96	S.
	C 2nd May 1934.	Do.	87	11·40±0·60	+4·92±0·72	S.
	D 15th May 1934.	Do.	93	10·92±0·60	+4·44±0·72	S.
	E 1st June 1934.	Do.	88	6·48±0·36	Control.	
	F 15th June 1934.	Do.	88	5·28±0·24	—1·20±0·48	S.

264. *Premonsoon stump planting—Dalbergia latifolia (vide paragraph* 59)—

Experiment No. 47—*Top slip Experimental Garden—Arrangement*—ABCDEFFEDCBA repeated 10 times in single lines of 10 plants, i.e., 100 plants of each date.—*Espacements* 3′ × 3′. *Soil preparation*—Crowbar holes. *Stock used*—One year stumps 0·1″—0·2″ diameter. *Dates of stump planting*—Fortnightly from 16th March 1934 to 1st June 1934. *Treatment*—Kept free of weeds and grass.

Experiment No. 41—*Experimental Garden, Dhoni.—Arrangement, etc.*, as above. *Espacement* 2′ × 2′. *Stock used*—One year stumps 0·1″ — 0·2″ diameter. *Date of stump planting*—Fortnightly from 16th March 1934 to 1st June 1934. *Treatment*—Kept free of weeds and grass.

Experiment No. 1 (*b*)—*Kannoth Experimental Garden—Arrangement*, as above but 50 plants of each date. *Espacement*—6′ × 3′. *Stock used*—One year stumps 0·3″ diameter. *Dates of stump planting*—Fortnightly from 2nd April 1934 15th July 1934. This experiment was done in a ponam crop of hill paddy.

Growth data.

Experiment.	Treatment. Date of planting.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Top slip—Experimental garden 47.	A 16th March 1934.	31st January 1935.	63	21·5±1·42	+9· 5±1·67	S.
	B 1st April 1934.	Do.	43	22·7±2·09	+10·7±2·39	S.
	C 16th April 1934.	Do.	52	17·4±1·34	+5·4±1·63	S.
	D 1st May 1934.	Do.	79	15·0±0·90	+3·0±1·26	S.
	E 16th May 1934.	Do.	75	13·7±0·74	+1·7±1·15	N.S.
	F 1st June 1934.	Do.	57	12·0±0·88	Control.	
Dhoni—Experimental garden 41.	A 16th March 1934.	5th February 1935.	11	19·82±3·65	+3·92±3·92	N.S
	B 1st April 1934.	Do.	18	20·06±2·89	+4·16±2·78	N.S.
	C 16th April 1934.	Do.	64	27·25±0·82	+11·35±1·65	S.
	D 1st May 1934.	Do.	84	20·71±1·17	+4·81±1·85	S.
	E 16th May 1934.	Do.	64	19·97±1·15	+4·07±1·84	S.
	F 1st June 1934.	Do.	48	15·90±1·43	Control.	
Kannoth—Experimental garden 1 (*b*).	A 2nd April 1934.	21st April 1935.	74	23·40±2·04	+4·08±2·40	N.S.
	B 15th April 1934.	Do.	98	26·16±1·68	+6·84±2·16	S.
	C 2nd May 1934.	Do.	88	23·16±1·44	+4·84±2·04	S.
	D 15th May 1934.	Do.	96	25·08±1·20	+5·76±1·92	S.
	E 1st June 1934.	Do.	92	19·32±1·44	Control.	
	F 15th June 1934.	Do.	90	13·36±9·96	—5·96±1·80	S.

265. *Premonsoon stump planting Pterocarpus marsupium* (*vide paragraph* 60)—

Experiment No. 46 *Top slip Experimental Garden—Arrangement*—A B C D E F F E D C B A repeated 10 times in single lines of 10 plants (i.e. 100 plants of each date). *Espacement*—3′ × 3′. *Soil preparation*—Crowbar holes. *Stock used*—One year stumps 0·2″ to 0·5″ diameter. *Dates of stump planting*—Fortnightly from 16th March 1934 to 1st June 1934. *Treatment*—Kept free of grass and weeds.

Experiment No. 40—*Dhoni Experimental Garden—Arrangement, etc.*, as above. *Espacement*—2′ × 2′. *Stock used*—One year stumps 0·3″ to 0·4″ diameter. *Dates of stump planting*—Fortnightly from 16th March 1934 to 1st June 1934. *Treatment*—Kept free of weeds.

Experiment No. 1 (*c*)—*Kannoth Experimental Garden—Arrangement, etc.*, as above but 50 plants of each date. *Espacement*—6′ × 3′. *Stock used*—One year stumps 0·4″—0·5″ diameter. *Dates of stump planting*—Fortnightly from 2nd April 1934 to 15th June 1934.

NOTE.—This experiment was done in a ponam crop of hill paddy.

Growth data.

Experiment.	Treatment. Date of planting.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Topslip Experimental Garden No. 46.	A 16th March 1934.	31st January 1935.	71	13·38±0·60	+4·33±0·77	S.
	B 1st April 1934.	Do.	72	13·06±0·78	+4·01±0·92	S.
	C 16th April 1934.	Do.	87	15·32±0·90	+6·27±1·02	S.
	D 1st May 1934.	Do.	81	10·69±0·53	+1·64±0·72	S.
	E 16th May 1934.	Do.	85	9·21±0·48	+0·16±0·68	N.S.
	F 1st June 1934.	Do.	85	9·05±0·48	Control.	
Dhoni Experimental Garden No. 40.	A 16th March 1934.	5th February 1935.	8	17·88±3·61	+0·37±3·79	N.S.
	B 1st April 1934.	Do.	7	42·86±8·85	+25·35±8·91	S.
	C 16th April 1934.	Do.	90	27·11+1·37	+9·60±1·78	S.
	D 1st May 1934.	Do.	48	19·77±1·52	+2·26±1·90	N.S.
	E 16th May 1934.	Do.	26	17·54±2·06	—0·03±2·36	N.S.
	F 1st June 1934.	Do.	76	17·51±1·15	Control.	
Kannoth Experimental Garden No. 1 (*c*).	A 2nd April 1934.	21st April 1935.	38	29·04±1·80	—15·36±3·76	S.
	B 15th April 1934.	Do.	70	46·56±3·48	+2·16±5·04	N.S.
	C 1st May 1934.	Do.	88	54·12±2·68	+9·72±4·56	S.
	D 15th May 1934.	Do.	100	54·84±3·36	+10·44±4·92	S.
	E 1st June 1934	Do.	96	44·40±3·60	Control.	
	F 15th June 1934	Do.	82	31·80±2·52	— 12·60±4·44	S·

266. *Premonsoon stump planting—Xylia xylocarpa* (*vide paragraph* 61)—

Experiment No. 48—*Topslip Experimental Garden.—Arrangement*—ABCDEF FEDCBA repeated ten times in single lines of ten plants (i.e., 100 plants per treatment). *Espacement*—3′ × 3′. *Soil preparation*—Crowbar holes. *Stock used*—one year stumps 0·1″ to 0·3″ diameter. *Dates of stump planting*—Fortnightly from 16th March 1934 to 1st June 1934. *Treatment*—Kept free of weeds and grass.

Experiment No. 43—*Dhoni Experimental Garden.—Arrangement*, etc., as above. *Espacement*—2′ × 2′. *Stock used*—One year stumps 0·1′ to 0·2″ diameter. *Date of stump planting*—Fortnightly from 16th March 1934 to 1st June 1934. *Treatment*—Kept free of weeds and grass.

Growth data.

Experiment.	Treatment. Date of planting.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Topslip Experimental Garden 48.	A. 16th March 1934.	31st January 1935.	20	3·45±0·24	+1·45±0·26	S.
	B. 1st April 1934.	Do.	24	3·17±0·30	+1·17±0·37	S.
	C. 16th April 1934.	Do.	87	5·00±0·26	+ 3·00±0·28	S.
	D. 1st May 1934.	Do.	52	2·94±0·12	+0·94±0·15	S.
	E. 16th May 1934.	Do.	65	2·71±0·13	+0·71±0·16	S.
	F. 1st June 1934.	Do.	5	2·00±0·08	Control.	
Dhoni Experimental Garden No. 43.	A. 16th March 1934.	5th February 1935.	0	..	..	
	B. 1st April 1934.	Do.	16	3·75±0·38	—1·25±0·59	S.
	C. 16th April 1934.	Do.	6	5·33±0·39	+0·33±0·59	N.S.
	D. 1st May 1934.	Do.	42	4·14±0·48	—0·86±0·65	N.S.
	E. 16th May 1934.	Do.	28	5·00±0·45	Control.	
	F. 1st June 1934.	Do.	2	3·00±	Too few survivals.	

267. *Stump planting—Effect of Age of stock used—Teak (vide paragraph* 64)—

Experiment No. 53—*Dhoni Experimental Garden.—Arrangement*—AB BA repeated ten times in single lines of ten plants (i.e., 100 plants per treatment). *Espacement*—6′ × 3′. *Soil preparation*—Crowbar holes. *Stock used*—October stumps 0·1″ to 0·2″ diameter and 4″ to 7″ root. April stumps 0·4″ to 0·6″ diameter and 9″ root. *Date of stump planting*—30th April 1934. *Treatment*—Normal district weeding.

Experiment No. 59—*Topslip Experimental Garden.—Arrangement etc.*—As above. *Stock used.*—October stumps 0·1″ to 0·3″ diameter and 4″ to 6″ root. April stumps 0·4″ to 0·7″ diameter and 9″ root. *Date of stump planting*—29th April 1934.

Experiment No. 34—*Begur Experimental Garden.—Arrangement etc.*—As above. *Stock used.*—October stumps 0·2″ to 0·4″ diameter and 4″ to 6″ root. April stumps 0·4″ to 0·7″ diameter and 9″ root. *Date of stump planting*—22nd June 1934.

Growth data after one season.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Dhoni Experimental Garden No. 53.	April stumps ..	7th February 1935.	83	11·7±0·51	+2·9±0·83	S.
	October stumps.	Do.	26	8·8±0·65	Control.	
Topslip Experimental Garden No. 59.	April stumps ..	1st February 1935.	93	26·71±1·11	Cobtrol.	
	October stumps.	Do.	52	23·70±1·33	—3·03±1·74	N.S.
Begur Experimental Garden No. 34.	April stumps ..	22nd December 1934.	92	6·02±0·24	+2·54±0·48	S.
	October stumps.	Do.	33	3·48±0·36	Control.	

268. *Stump planting—Effect of diameter of stumps—Teak.—(vide paragraph* 66)—

Experiment No. 54.—*Dhoni Experimental Garden.—Arrangement*—ABC CBA repeated ten times in single lines of ten

plants (i.e., 100 plants per treatment). *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes. *Stock used*—one year stumps. (A) 0·3″ to 0·4″ diameter. (B) 0·5″ to 0·6″ diameter. (C) 0·7″ to 0·8″ diameter. *Date of stump planting*—30th April 1934. *Treatment*—Normal district weeding.

Experiment No. 63.—*Topslip Experimental Garden—Arrangement etc.*—As above only for four treatments. *Stock used*—One year stumps. (D) 0·3″ to 0·4″ diameter. (C) 0·4″ to 0·5″. (B) 0·5″ to 0·6″. (A) 0·6″ to 0·7″ diameter. *Date of stump planting*—28th April 1934.

Experiment 31 A.—*Begur Experimental Garden—Arrangement, etc.*—As above only for eight treatments. *Stock used*—Stumps *one year old.* (A) 0·4″ diameter. (B) 0·6″ diameter. (C) 0·8″ diameter. (D) 1·0″ diameter. *Two year old.* (E) 0·8″ diameter. (F) 1·0″ diameter. (G) 1·2″ to 1·4″ diameter. *Three years old.* (H) 1·8″ to 2·0″ diameter. *Date of stump planting*—24th May 1934.

Data after one season's growth.

Experiment.	Diameter of stumps.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Dhoni Experimental Garden No. 54.	0·3″–0·4″	7th February 1935.	85	11·39±0·51	—0·94±0·78	N.S.
	0·5″–0·6″	Do.	84	12·33±0·59	Control.	
	0·7″–0·8″	Do.	84	13·11±0·61	+0·78±0·84	N.S.
Topslip Experimental Garden No. 63.	0·3″–0·4″	2nd February 1935.	76	19·87±1·18	+0·04±1·56	N.S.
	0·4″–0·5″	Do.	89	19·19±1·04	—0·64±1·45	N.S.
	0·5″–0·6″	Do.	94	19·83±1·02	Control.	
	0·6″–0·7″	Do.	96	25·43±1·05	+5·60±1·46	S.
Begur Experimental Garden No. 31-A.	One year. 0·4″	26th February 1935.	56	7·56±0·48	—2·04±0·72	S.
	0·6″	Do.	79	8·16±0·48	—1·44±0·72	S.
	0·8″	Do.	71	9·60±0·05	Control.	
	1·0″	Do.	58	10·08±0·72	+0·48±0·84	N.S.
	Two years 0·8″	Do.	70	12·48±0·72	+2·88±0·84	S.
	1·0″	Do.	72	11·40±0·60	+1·80±0·84	S.
	1·4″	Do.	68	11·04±0·60	+1·44±0·84	N.S.
	Three years 1·8″ / 2·0″	Do.	30	8·16±0·72	—1·44±0·96	N.S.

269. *Stump planting—Effect of diameter of stumps—Dalbergia Latifolia* (*vide paragraph* 67)—

Experiment No. 54—*Topslip Experimental Garden—Arrangement.*—ABCD DCBA repeated ten times in single lines of ten plants (i.e., 100 for each treatment). *Espacement*—6′ × 3′. *Soil preparation*—Crowbar holes. *Stock used*—Stumps one year old (A) 0·1″ to 0·2″ diameter. (B) 0·2″ to 0·3″ diameter. Stumps two years old. (C) 0·1″ to 0·2″ diameter. (D) 0·2″ to 0·03″ diameter. *Date of stump planting*—28th April 1934. *Treatment*—Normal district weeding.

Experiment No. 31. *B—Begur Experimental Garden.—Arrangement, etc.*—As above only for six treatments. *Stock used*—One year stumps. (A) 0·1″ diameter. (B) 0·2″ diameter.

(D) 0·2″ diameter. (C) 0·3″ diameter. (E) 0·3″ diameter. (F) 0·4″ diameter. *Date of stump planting*—26th May 1934.

Growth data after one season.

Experiment.	Age and diameter of stumps.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Topslip Experimental Garden No. 54.	One year. 0·1″–0·2″	1st February 1935.	30	13·40±0·97	Control.	
	Do. 0·2″–0·3″	Do.	58	18·21±1·02	+4·31±1·40	S.
	Two years. 0·1″–0·2″	Do.	56	15·46±0·95	+2·06±1·35	S.
	Do. 0·2″–0·3″	Do.	74	20·57±1·07	+7·17±1·44	S.
Begur Experimental Garden No. 31-B.	One year 0·1″	28th December 1934.	49	6·24±0·36	—0·24±0·48	N.S.
	Do. 0·2″	Do.	83	6·48±0·36	Control.	
	Do. 0·3″	Do.	74	8·64±0·48	+2·16±0·60	S.
	Two years 0·2″	Do.	81	6·96±0·36	+0·48±0·48	N.S.
	Do. 0·3″	Do.	92	6·96±0·36	+0·48±0·48	N.S.
	Do. 0·4″	Do.	93	8·04±0·72	+1·56±0·84	N.S.

270. *Stump planting—Effect of diameter of stumps—Pterocarpus marsupium* (*vide paragraph* 68)—

Experiment No. 55—*Topslip Experimental Garden.—Arrangement*—ABCDEFGH HGFEDCBA repeated five times in single lines of ten plants, i.e., 50 plants per treatment. *Espacement*—6′ × 3′. *Soil preparation*—Crowbar holes. *Stump used*—Stumps one year old. (A) 0·1″ to 0·2″ diameter. (B) 0·2″ to 0·3″ diameter. (C) 0·3″ to 0·4″ diameter. (D) 0·4″ to 0·5″ diameter. Two years old. (E) 0·3″ to 0·4″ diameter. (F) 0·4″ to 0·5″ diameter. (G) 0·5″ to 0·6″ diameter. (H) 0·6″ to 0·8″ diameter. *Date of stump planting*—28th April 1934. *Treatment*—Normal district weeding.

Growth data after one season.

Experiment.	Age and diameter of stumps.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Signficance.
Topslip Experimental Garden No. 55.	One year. 0·1″–0·2″	1st February 1935.	42	8·14±0·89	—1·48±1·07	N.S.
	Do. 0·2″–0·3″	Do.	70	8·34±0·65	—1·28±0·88	N.S.
	Do. 0·3″–0·4″	Do.	74	9·62±0·60	Control.	
	Do. 0·4″–0·5″	Do.	70	11·43±0·96	+1·81±1·13	N.S.
	Two years. 0·3″–0·4″	Do.	64	12·91±1·00	+3·29±1·17	S.
	Do. 0·4″–0·5″	Do.	76	15·26±1·08	+5·64±1·24	S.
	Do. 0·5″–0·6″	Do.	84	17·70±1·54	+8·08±1·65	S.
	Do. 0·6″–0·8″	Do.	90	18·16±1·22	+8·54±1·36	S.

271. *Stump planting—Effect of diameter of stumps—Teriminalia crenulata* (*vide paragraph* 69)—

Experiment 39.—*Dhoni Experimental Garden.—Arrangement*—ABCD DCBA repeated ten times in single lines of ten plants, i.e., 100 plants per treatment. *Espacement*—6′ × 3′. *Soil preparation*—Crowbar holes. *Stock used*—One year stumps. (A) 0·2″ to 0·3″ diameter. (B) 0·4″ to 0·5″ diameter. (C) 0·6″ to 0·7″ diameter. (D) 0·8″ to 0·9″ diameter. *Date of stump planting*—20th April 1934. *Treatment*—Normal district weeding.

Experiment No. 52—*Topslip Experimental Garden—Arrangement etc.*,—As above but in lines of five plants, i.e., 50 plants per treatment. *Stock used*—One year stumps. (A) 0·4″ to 0·5″ diameter. (B) 0·5″ to 0·6″ diameter. (C) 0·6″ to 0·7″ diameter. (D) 0·7″ to 0·8″ diameter. *Date of stump planting*—28th April 1934.

Experiment 31 C.—*Begur Experimental Garden—Arrangement, etc.*—As above, for five treatments and 100 plants of each treatment. *Stock used*—one year stumps—(A) 0·6″ diameter. (B) 0·8″ diameter. (C) 1·0″ diameter. Two years stumps—(D) 0·8″ diameter. (E) 1·0″ diameter. *Date of stump planting*—26th May 1934.

Growth data after one season.

Experiment.	Age and diameter of stumps.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
honi Experimental Garden No. 39.	0·2″-0·3″	5th February 1935.	52	18·90±1·42	—7·65±1·71	S.
	0·4″-0·5″	Do.	82	27·50±1·08	+0·95±1·43	N.S.
	0·6″-0·7″	Do.	90	28·00±0·85	+1·45±1·27	N.S.
	0·8″-0·9″	Do.	80	26·55±0·94	Control.	
Topslip Experimental Garden No. 52.	0·4″-0·5″	1st February 1935.	46	32·39±2·92	—0·50±3·29	N.S.
	0·5″-0·6″	Do.	70	32·89±1·59	Control.	
	0·6″-0·7″	Do.	68	34·29±1·71	+1·40±2·33	N.S.
	0·7″-0·8″	Do.	84	30·79±1·59	—2·10±2·24	N.S.
Begur Experimental Garden No. 31-C.	One year 0·6″	28th December 1934.	50	17·28±2·52	—2·64±2·76	N.S.
	Do. 0·8″	Do.	38	19·92±1·20	Control.	
	Do. 1·0″	Do.	50	15·96±1·92	—3·96±2·16	N.S.
	Two years 0·8″	Do.	54	19·80±2·52	—0·12±2·76	N.S.
	Do. 1·0″	Do.	38	16·44±1·32	—3·48±1·68	S.

272. *Stump planting—Effect of diameter of stumps—Artocarpus hirsuta (vide paragraph* 70)—

Experiment 6.—*Kannoth Experimental Garden—Arrangement*—ABCDEF FEDCBA repeated five times in single lines of ten plants (i.e., 50 plants per treatment). *Espacement*—6′ × 3′. *Soil preparation*—Crowbar holes. *Stock used*—One year stumps. (A) 0·2″ to 0·3″ diameter. (B) 0·3″ to 0·4″ diameter. (C) 0·4″ to 0·5″ diameter. *Two year stumps.* (D) 0·3″ to 0·4″ diameter. (E) 0·4″ to 0·5″ diameter. (F) 0·5″ to 0·6″ diameter. *Date of stump planting*—12th June 1934. *Treatment*—Normal district weeding.

Note.—This experiment was done in a ponam crop of hill paddy.

Growth data after one season.

Experiment.	Age in years.	Diameter in inches.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Kannoth—Experimental Garden No. 6.	1	0·2″-0·3″	56	8·16±1·08	—8·40±1·44	S.
		0·3″-0·4″	68	10·56±1·08	—5·64±1·44	S.
		0·4″-0·5″	92	12·12±1·08	—4·08±1·44	S.
	2	0·3″-0·4″	84	9·84±0·96	—6·36±1·32	S.
		0·4″-0·5″	88	13·08±0·96	—3·12±1·44	S.
		0·5″-0·6″	96	16·20±0·96	Control.	

273. *Stump planting—Effect of length of root—Teak* (*vide paragraph* 71)—

Experiment No. 66—*Topslip Experimental Garden.—Arrangement.*—ABCDEFGH HGFEDCBA repeated five times in single lines of 20 plants (i.e., 100 plants per treatment). *Espacement* 6′ × 3′. *Soil preparation.*—Crowbar holes. *Stock used*—One year stumps. A B C D 0·2″ to 0·4″ diameter, length of root 4″ 6″ 8″ and 10″ respectively. E F G H 0·7″ to 0·8″ diameter—length of root 4″ 6″ 8″ and 10″ respectively. *Date of stump planting*—30th April 1934—*Treatment*—Normal district weeding.

Experiment No. 55—*Dhoni experimental Garden.—Arrangement, etc.*—As above. *Date of stump planting*—7th May 1934.

Experiment No. 30—*Begur Experimental Garden.—Arrangement*—As above but A-1, A-2, B-1, B-2, C-1, C-2, D-1, D-2, D-2, D-1, C-2, C-1, etc.—*Stock used*—One year stumps. A-1—10″ root 0·7″ to 0·8″ diameter. A-2—10″ root 0·3″ to 0·4″ diameter. B-1—8″ root 0·7″ to 0·8″ diameter. B-2—8″ root 0·3″ to 0·4″ diameter. C-1—6″ root 0·7″ to 0·8″ diameter. C-2—6″ root 0 3″ to 0·4″ diameter. D-1—4″ root 0·7″ to 0·8″ diameter. D-2—4″ root 0·3″ to 0·4″ diameter. *Date of stump planting*—19th May 1934—*Treatment*—Normal district weeding.

Experiment No. 2—*Kannoth Experimental Garden.—Arrangement, etc.*—As above. *Date of stump planting*—29th May 1934.

NOTE.—This experiment was done in a ponam crop of hill paddy.

Data after one season's growth.

Experiment.	Treatment.		Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
	Diameter.	Root length.					
Topslip Experimental Garden No. 66.	A. 0·3″—0·4″	4″	2nd February 1935.	39	12·36 ± 1·22	+ 0·10 ± 1·39	N.S.
	B. Do.	6″	Do.	56	14·13 ± 1·24	+ 1·87 ± 1·42	N.S.
	C. Do.	8″	Do.	76	12·26 ± 0·69	Control.	
	D. Do.	10″	Do.	73	14·23 ± 0·70	+ 1·97 ± 0·98	S.
	E. 0·7″—0·8″	4″	2nd February 1935.	74	12·24 ± 0·77	— 2·41 ± 1·05	S.
	F. Do.	6″	Do.	83	13·55 ± 0·65	— 1·10 ± 0·97	N.S.
	G. Do.	8″	Do.	93	14·65 ± 0·71	Control.	
	H. Do.	10″	Do.	86	15·40 ± 0·75	+ 0·75 ± 1·03	N.S.
Dhoni Experimental Garden No. 55.	A. 0·3″—0·4″	4″	6th February 1935.	67	9·63 ± 0·61	+ 2·17 ± 0·68	S.
	B. Do.	6″	Do.	69	7·42 ± 0·34	— 0·04 ± 0·44	N.S.
	C. Do.	8″	Do.	78	7·46 ± 0·29	Control.	
	D. Do.	10″	Do.	79	9·06 ± 0·43	+ 1·60 ± 0·52	S.
	E. 0·7″—0·8″	4″	6th February 1935.	60	9·73 ± 0·52	— 3·54 ± 0·82	S.
	F. Do.	6″	Do.	81	10·62 ± 0·51	— 2·65 ± 0·81	S.
	G. Do.	8″	Do.	73	13·27 ± 0·63	Control.	
	H. Do.	10″	Do.	84	12·05 ± 0·49	— 1·22 ± 0·80	N.S.
Begur Experimental Garden No. 30.	D.2. 0·3″—0·4″	4″	27th February 1935.	27	4·92 ± 0·48	— 0·84 ± 0·72	N.S.
	C.2. Do.	6″	Do.	38	5·04 ± 0·36	— 0·72 ± 0·60	N.S.
	B.2. Do.	8″	Do.	33	5·76 ± 0·48	Control.	
	A.2. Do.	10″	Do.	59	6·12 ± 0·36	+ 0·36 ± 0·60	N.S.

Data after one season's growth—cont.

Experiment.	Treatment. Diameter.	Root length.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Begur Experimental Garden No. 30—*cont.*	D.1. 0·7″—0·8″	4″	27th February 1935.	66	7·03±0·60	— 0·12±0·72	N.S.
	C.1. Do.	6″	Do.	66	8·52±0·48	+ 1·32±0·72	N.S.
	B.1. Do.	8″	Do.	76	7·20±0·48	Control.	
	A.1. Do.	10″	Do.	84	7·68±0·48	+ 0·48±0·60	N.S.
Kannoth Experimental Garden No. 2.	D.2. 0·3″—0·4″	4″	8th January 1935.	60	7·44±0·60	— 1·08±0·73	N.S.
	C.2. Do.	6″	Do.	68	8·28±0·48	— 0·24±0·73	N.S.
	B.2. Do.	8″	Do.	74	8·52±0·60	Control.	
	A.2. Do.	10″	Do.	57	8·28±0·60	— 0·24±0·78	N.S.
	D.1. 0·7″—0·8″	4″	8th January 1935.	85	12·48±0·72	— 0·72±0·86	N.S.
	C.1. Do.	6″	Do.	95	13·08±0·60	— 0·12±0·91	N.S.
	B.1. Do.	8″	Do.	95	13·20±0·60	Control.	
	A.1. Do.	10″	Do.	91	14·64±0·60	+ 1·44±0·86	N.S.

274. *Stump planting—Comparison of pits and crowbar holes—Teak (vide paragraph* 74)—

Experiment No. 53—*Topslip Experimental Garden.—Arrangement.*—ABC CBA repeated 10 times in single lines of 10 plants (i.e., 100 of each treatment). *Espacement*—6′×3′. *Soil preparation*—A. Standard 1′ cube pits. B. Ordinary crowbar holes. C. Soil lossened at the stake and a crowbar hole made in the centre. *Stock used*—1 year stumps 0·5″ to 0·6″ diameter. *Date of stump planting*—30th April 1934—*Treatment*—Normal district weeding.

Experiment No. 37—*Dhoni Experimental Garden.—Arrangement, etc.*—As above. *Stock used*—1 year stumps 0·4″ to 0·5″ diameter. *Date of stump planting*—18th April 1934.

Experiment No. 29—*Begur Experimental Garden.—Arrangement, etc.*—As above. *Stock used*—1 year stumps 0·4″ to 0·5″ diameter. *Date of stump planting*—19th May 1934.

Experiment No. 3—*Kannoth Experimental Garden.—Arrangement, etc.*—As above. *Stock used*—1 year stumps 0·2″ to 0·5″ diameter. *Date of stump planting*—29th May 1934.

NOTE.—This experiment was done in a ponam crop of hill paddy.

Data after one season's growth.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference of means from control.	Significance.
Topslip—Experimental garden, No. 53.	A. Standard pits.	1st February 1935	87	35·84±1·47	+3·30 ± 2·16	N.S.
	B. Crowbar holes.	Do.	96	32·54±1·63	Control.	
	C. Crowbar holes in loosened soil.	Do.	92	32·54±1·66	0·00 ± 2·32	N.S.
Dhoni—Experimental garden No. 37	A. Standard pits.	5th February 1935.	100	25·6±1·00	+1·80±1·40	N.S.
	B. Crowbar holes.	Do.	98	23·98±0·98	Control.	
	C. Crowbar holes in loosened soil.	Do.	99	25·40±1·05	+1·60±1·44	N.S.

Data after one season's growth—cont.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference of means from control.	Significance.
Begur Experimental Garden, No. 29.	A. Standard pits.	26th February 1935.	98	8·88 ± 0·36	+ 0·84 ± 0·60	N.S.
	C. Crowbar holes.	Do.	97	8·04 ± 0·36	Control.	
	B. Crowbar holes in loosened soil.	Do.	95	7·92 ± 0·36	+ 0·13 ± 0·60	N.S.
Kannoth Experimental Garden, No. 3.	A. Standard pits.	7th January 1935.	69	5·52 ± 0·24	+ 0·48 ± 0·36	N.S.
	C. Crowbar holes.	Do.	75	5·04 ± 0·24	Control.	
	B. Crowbar holes in loosened soil.	Do.	63	5·04 ± 0·24	± 0·00 ± 0·48	N.S.

275. *Stump planting—Storage of Stumps—Teak—(vide paragraph* 79)—

Topslip Experimental Garden—Experiment No. 62.—*Arrangement*—ABCDEFG GFEDCBA repeated 10 times in single lines of 10 plants (i.e., 100 stumps of each date). *Espacement*—6′ × 3′. *Soil preparation*—Crowbar holes. *Treatment*—Stumps were prepared on April 7th, 12th, 17th, 22nd and 27th and May 2nd and 11th. *Stock used*—1 year stumps 0·3″ to 0·6″ diameter. *Date of stump planting*—12th May 1935. *Tending*—Normal district weeding.

Begur Experimental Garden—Experiment No. 27.—*Arrangement, etc.*—As above. *Treatment*—Stumps were prepared on April 5th, 10th, 15th, 20th, 25th, 30th and May 9th. *Stock used*—1 year stumps 0·3″ to 0·4″ diameter. *Date of stump planting*—9th May 1934.

Dhoni Experimental Garden—Experiment No. 52—*Arrangement, etc.*—As above. *Treatment*—Stumps were prepared on April 6th, 11th, 16th, 21st, 26th and May 1st and 10th. *Stock used*—1 year stumps 0·4″ to 0·7″ diameter. *Date of stump planting*—10th May 1934.

Data after one season's growth.

Experiment.	Stumps prepared on	Number of days storage.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Topslip Experimental Garden, No. 2.	7th April 1934.	35	1st February 1935.	19	17·05 ± 2·10	— 20·45 ± 2·52	S.
	12th April 1934.	30	Do.	23	21·65 ± 2·18	— 15·85 ± 2·58	S.
	17th April 1934.	25	Do.	24	28·88 ± 2·84	— 8·62 ± 3·16	S.
	22nd April 1934.	20	Do.	60	30·82 ± 1·96	— 6·68 ± 2·40	S.
	27th April 1934.	15	Do.	45	27·27 ± 2·00	— 10·23 ± 2·42	S.
	2nd May 1934.	10	Do.	64	30·28 ± 1·93	— 7·22 ± 2·38	S.
	11th May 1934.	1	Do.	95	37·50 ± 1·37	Control.	

Data after one season's growth—cont.

Experiment.	Stumps prepared on	Number of days storage.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Begur Experimental garden No. 27.	5th April 1934.	34	15th February 1935.	15	10·32±1·92	— 11·54±2·40	S.
	10th April 1934.	29	Do.	10	8·16±1·68	— 13·68±2·18	S.
	15th April 1934.	24	Do.	3	9·12±3·60	— 12·74±3·84	S.
	20th April 1934.	19	Do.	51	10·44±0·48	— 11·40±1·56	S.
	25th April 1934.	14	Do.	85	16·56±0·48	— 5·28±1·56	S.
	30th April 1934.	9	Do.	84	17·88±1·08	— 3·96±1·80	S.
	9th May 1934.	0	Do.	88	21·84±1·44	Control.	
Dhoni Experimental garden No. 52.	6th April 1934.	34	1st February 1935.	19	12·16±1·24	— 0·43±1·36	N.S.
	11th April 1934.	29	Do.	59	12·95±0·65	+ 0·36±0·86	N.S.
	16th April 1934.	24	Do.	73	9·7 ±0·43	— 2·89±0·71	S.
	21st April 1934.	19	Do.	91	12·81±0·56	+ 0·22±0·80	N.S.
	26th April 1934.	14	Do.	77	10·38±0·53	— 2·21±0·78	S.
	1st May 1934.	10	Do.	87	12·08±0·57	— 0·51±0·81	N.S.
	10th May 1934.	0	Do.	92	12·59±0·56	Control.	

276. *Stump planting, Transport of Stumps—Teak* (*vide* paragraph 81)—

Experiment No. 67—*Topslip Experimental Garden.—Arrangement*—A. B. B. A. repeated 20 times in lines of 10 plants (i.e., 200 of each treatment). *Espacement*—6′ × 3′. *Soil preparation*—Crowbar holes. *Stock used*—1 year stumps 0·4″ to 0·7″ diameter. *Date of stump planting*—28th April 1934. *Treatment*—Normal district weeding.

Experiment No. 2—*Walayar Experimental Garden.—Arrangement, etc.*—As above. *Espacement*—6′ × 6′. *Stock used*—1 year stumps 0·4″ to 0·7″ diameter. *Date of stump planting*—25th April 1934.

Experiment No. 26—*Begur Experimental Garden.—Arrangement, etc.*—As above. *Stock used*—1 year stumps 0·3″ to 0·7″ diameter. *Date of stump planting*—1st May 1934.

Growth Data after one season.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Top slip Experimental garden No. 67.	Local stumps.	2nd February 1935.	85	13·02±0·45	Control.	
	Nilambur stumps.	Do.	99	15·87±0·51	+ 2·85±0·68	S.
Walayar Experimental garden No. 2.	Local stumps.	14th February 1935.	79	11·50±0·44	Control.	
	Nilambur stumps.	Do.	71	11·96±0·42	+ 0·46±0·61	N.S.
Begur Experimental garden No. 28.	Local stumps.	26th February 1935.	92	23·40±1·08	Control.	
	Nilambur stumps.	Do.	99	30·77±1·68	+7·37±1·92	S.

277. *Effect of Taungya (ponam) Crops on the Growth of Teak in a plantation (vide paragraph* 88)—

Experimental Plot No. 17 *Wynaad Division* (in 1934 teak plantation). *Arrangement*—The area of 70 × 40 stakes is arranged in 28 randomised blocks of 10 × 10 stakes, i.e., 4 repetitions of 7 treatments. *Espacement*—6′ × 6″. *Treatments*—Ponam crops A—Dhall. B.C.D. Ragi. E.F.G. Control—No ponam crop. (This arrangement is for use with other crops in the second year). *Dhall sown in patches*—20th June 1934. Harvested 18th January 1935. *Ragi broadcast*—28th June 1934. Harvested 20th November 1934. *Tending*—E.F.G. Ordinary divisional tending practice carried out. A.—Minimum weeding done. B. C.D.—Ragi kept away from the teak by weeding 2′ diameter circles in August. All areas clean scraped in early January 1935.

Treatment.	First year ponam crop.	Percentage of survivals.	Mean height of teak in feet.	Difference of means.	Significance.
A	Dhall ..	96	2·08 ± 0·96	+ 0·29 ± 0·13	S
B	Ragi ..	95	1·33 ± 0·58	— 0·46 ± 0·10	S
C	Do. ..	95	1·35 ± 0·56	— 0·44 ± 0·10	S
D	Do. ..	95	1·49 ± 0·68	— 0·30 ± 0·11	S
E	Control ..	95	1·66 ± 0·76	— 0·13 ± 0·11	N.S.
F	Do. ..	95	1·64 ± 0·72	— 0·15 ± 0·11	N.S.
G	Do. ..	99	1.79 ± 0·84	Control.	..

Measurements taken on 31st January 1935. (In the second year the following crops are being used). A. Dhall. B. Sunn hemp. C. Boga. D. Nil. E. Sunn hemp. F. Boga. G. Control.

278. *Comparison of early and late stump planting of teak in a plantation with and without a ponam crop of ragi*—(*vide paragraph* 94)—

Experimental Plot No. 18—*Wynaad Division.*—*Arrangement*—The plot of 40 × 40 stakes divided into 16 blocks 10 × 10 arranged in a latin square of the 4 repetitions of 4 treatments. *Espacement*—6′ × 6′. *Treatments*—A. Early planting with ponam. B. Early planting without ponam. C. Late planting with ponam. D. Late planting without ponam. *Date of treatment*—A. and B. Early planting on 21st April 1934. C. and D. Late planting on 23rd May 1934. A and C. Ragi sown on 20th June 1934. Ragi harvested on 16th November 1934. *Tending*—B. and D.—Normal district weeding. A. and C.—Ragi uprooted in 1 foot radius circles round the teak plants.

Measurements in March 1935.

Treatment.	Percentage survivals.	Mean height growth in feet.	Difference of means.	Significance.
A. Early planting with ponam.	63	1·44 ± 0·06	+ 0·89 + 0·06	S
B. Early planting without ponam.	62	1·36 ± 0·06	+ 0·81 + 0·06	S
C. Late planting with ponam.	49	0·51 ± 0·01	— 0·04 + 0·02	Nearly significance.
D. Late planting without ponam.	47	0·55 ± 0·02	Control.	....

279. *Direct sowing in burned patches—Best season (vide paragraph* 102)—

Experiment 1 (i)—*Emmanur Experimental Garden.—Arrangement*—2 plots in open each with 12 lines of 50 stakes ABCDEF FEDCBA June to November and November back to June for each of 5 species, i.e., 200 of each treatment. *Espacement*—18″ × 18″. *Soil preparation*—Soil worked 9″× 9″×6″ at each stake, ash from the burn being worked into each pit.

Stock used—10 seeds per patch. *Dates of sowing*—On the 1st of each month from June to November. *Treatment*—Kept clean weeded throughout.

Species.	Percentage survivals on 1st July 1935 of seed sown on.						Mean height growth in inches in February 1935 of seed sown on.					
	1st June 1934.	1st July 1934.	1st August 1934.	1st September 1934.	1st October 1934.	1st November 1934.	1st June 1934.	1st July 1934.	1st August 1934.	1st September 1934.	1st October 1934.	1st November 1934.
Acacia ferruginea	17	21	23	12	27	39	5·9	6·2	6·1	5·4	7·3	6·0
Acacia sundra ..	36	32	23	36	54	15	6·1	4·4	3·8	3·4	3·6	1·9
Anacardium occidentale.	..	..	7	15	29	13	..	..	5·5	5·6	6·1	4·2
Albizzia amara ..	13	16	27	24	32	23	2·1	2·0	2·4	2·3	2·7	1·9
Cassia siamea ..	3	17	20	18	19	30	2·7	3·0	3·0	3·1	2·7	2·4

280. *Direct sowing Comparison of dry beds and watered beds (vide paragraph* 103)—

Experiment 1 (ii)—*Emmanur Experimental Garden.* [Supplementary to Experiment 1 (i) see paragraph 102]. *Arrangement*—Nursery beds 22′ × 4′ for each species. *Espacement*—$1\frac{1}{2}''$ × $1\frac{1}{2}''$. *Soil preparation*—Soil worked 18″ deep and smoothened, bed raised 3″ above ground level. *Stock used*—Two hundred seeds for each treatment. *Date of sowing*—On the first of each month from June to November. *Treatment*—Clean weeded throughout.

Direct sowing—Comparison of dry beds and watered beds.

Species.	Bed treatment.	Percentage of survivals of seed sown on					
		1st June 1934.	1st July 1934.	1st August 1934.	1st September 1934.	1st October. 1934.	1st November 1934.
Acacia ferruginea	Watered ..	34	40	27	40	61	40
	Dry ..	19	17	27	22	14	3
Acacia sundra	Watered ..	25	22	9	20	36	42
	Dry ..	15	14	17	25	28	6
Anacardium occidentale ..	Watered ..	19	57	7	4	21	3
	Dry ..	1	3	18	5	27	..
Albizzia amara	Watered ..	43	31	14	12	14	28
	Dry ..	8	4	3	4	3	2
Cassia siamea	Watered ..	14	20	19	17	22	5
	Dry ..	10	16	11	11	7	26

281. *Direct sowing—Comparison of burning and no burning soil working and no soil working (vide paragraph* 104)—

Experiment No. 5—*Emmanur Experimental Garden.—Arrangement*—Plot in the open five 100 feet strips side by side the first and last 6′ wide and the middle three 12′ wide. The second and fourth strips burned 4′ buffer lines left between burned and unburned strips. Fifty stakes per line in each treatment for each species (i.e., 200 per species per treatment). *Espacement*—2′ × 2′. *Soil preparation*—In soil worked area ground dug 9″ × 9″ × 6″; in burned area ash mixed with the soil. *Stock used*—Ten seeds per stake. *Date of sowing*—3rd July 1934. *Treatment*—Kept clean weeded throughout.

Species.	Percentage of survivals in February 1935. Area *not* burned. Worked pits.	Area *not* burned. Number soil working.	Area burned. Worked pits.	Area burned. Number soil working.	Mean height in inches in February 1935. Area *not* burned. Worked pits.	Area *not* burned. Number soil working.	Area burned. Worked pits.	Area burned. Number soil working.
Acacia leucophloea ..	50	48	68	78	1·9	1·8	2·3	2·3
Albizzia amara	74	84	75	79	3·1	2·8	3·4	3·3
Cassia siamea	86	89	92	94	5·8	5·6	8·4	9·1
Pithecolobium dulce ..	1	2	2	2	3·5	3·0	5·3	2·7
Tamarindus indica ..	31	40	33	28	4·3	4·3	4·7	4·2

282. *Direct sowing Comparison of sowing of untreated seed and sowing of germinating seed (vide paragraph* 105)—

Experiment No. 6—*Emmanur Experimental Garden.—Arrangement*—Plot in the open 100 patches of each treatment in lines of 20 patches arranged A.B.B.A., etc., repeated five times for each species—*Espacement*—2′ × 2′. *Soil preparation*—Area burned soil worked 9″ × 9″ × 6″ at each stake and ash mixed in. *Stock used*—Ten seeds per patch. *Date of sowing*—Untreated seed 6th July 1934 germinating seed 2nd October 1934 (seed germinated before sowing by placing between layers of straw and copiously watered). *Treatment*—Kept clean weeded throughout.

Species.	Survival percentage in February 1935. Untreated seed.	Survival percentage in February 1935. Germinating seed.	Mean height growth in inches in February 1935. Untreated seed.	Mean height growth in inches in February 1935. Germinating seed.
Acacia ferruginea	49	66	6·9	7·3
Acacia cyanophylla	6	8	1·0	1·3
Acacia sundra	26	58	5·3	4·7
Cassia fistula	19	14	2·9	2·8
Cassia marginata	26	26	2·9	2·9
Prosopis juliflora	34	74	7·5	9·7
Pterocarpus santalinus	..	3	..	2·0

283. *Comparison of sowing—Entire transplanting and stump planting (vide paragraph* 106)—

Experiment No. 4.—*Emmanur Experimental Garden.—Arrangement*—Plot in the open 50 stakes per line—layout ABC CBA —repeated twice (i.e., 100 of each treatment for each species).

Espacement—2″ × 2″ *Soil preparation*—Area burned and ash mixed with the soil, soil worked 9″ × 9″ × 6″ for sowing, 9″ crowbar holes for stump planting and soil worked 9″ × 9″ × 9″ for transplanting. *Stock used*—Sowing, 10 seeds per patch, transplanting and stump planting one year old plants from Chittoor nursery. *Date of sowing*—30th June 1934. *Date of stump planting*—15th September 1934. *Date of transplanting*—12th October 1934. *Treatment*—Kept clean weeded throughout.

Species.	Percentage of survivals in February 1935.			Mean height in inches in February 1935.		
	Sowing.	Transplanting.	Stump planting.	Sowing.	Transplanting.	Stumping.
Acacia ferruginea ..	49	58	..	8·0	5·9	..
Acacia leucophloea ..	28	84	..	2·3	3·3	..
Acacia sundra ..	10	14	..	3·9	3·9	..
Albizzia amara ..	74	88	..	2·8	3·6	..
Azadirachta indica ..	..	72	..	..	7·0	..
Cassia siamea	92	52	..	5·3	4·3	..
Holoptelia integrifolia.	3	77	..	2·7	5·9	..
Prosopis juliflora ..	38	59	..	2·9	3·1	..
Soymida febrifuga ..	1	75	..	2·0	2·3	..
Tamarindus indica ..	70	56	..	4·9	4·7	..

284. (i) *Stump planting—Best date*; (ii) *Stump planting and transplanting comparison*; (iii) *Comparison of transplanting at the commencement of the south-west and north-east monsoon* (*vide paragraph* 108)—

Experimental No. 2—*Emmanur Experimental Garden*—*Arrangement*—Plot in open in lines repeated twice 600 stumps and 200 transplants per species (i.e,, 100 per treatment) *Espacement*—2′ × 2′ *Soil preparation*—9″ crowbar holes for stump and soil worked 9″ × 9″ × 9″ at each stake for transplants after burning the area and working the ash into the soil. *Stock used*—One year old plants from Chittoor nursery. *Treatment*—Kept clean weeded throughout. *Dates of stump planting*—17th June 1934, 5th July 1934, 1st August 1934, 1st September 1934, 1st October 1934, and 8th October 1934. *Dates of transplanting*—17th June 1934; 9th October 1934.

	Percentage of survivals in February 1935 of stump planting on					
	17th June 1934.	5th July 1934.	1st August 1934.	1st September 1934.	1st October 1934.	8th October 1934.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Acacia auriculiformis ..	..	..	..	..	..	..
Cassia fistula ..	..	..	..	..	..	4
Cassia marginata ..	..	..	..	..	..	10
Chloroxylon swietenia.	..	..	..	..	..	25
Pterocarpus santalinus.	..	..	..	..	..	2

	Percentage survivals in February 1935 of plants transplanted on		Mean height in inches in February 1935 of stumps of	Mean height in inches in February 1935 of transplants of	
	17th June 1934.	9th October 1934.	8th October 1934.	17th June 1934.	9th October 1934.
	(8)	(9)	(10)	(11)	(12)
Acacia auriculiformis..	..	18	..	..	4·3
Cassia fistula ..	2	34	3·0	4·5	2·5
Cassia marginata ..	..	12	2·1	..	2·8
Chloroxyion swietenia.	..	78	1·6	..	1·9
Pterocarpus santalinus.	..	62	1·0	..	3·7

285. *Stump planting—Best date (vide paragraph* 109)—

Experiment No. 8—*Emmanur Experimental Garden.—Arrangement*—Hundred stakes in lines of 50 repeated twice per month for five months, the lines being arranged A B C D E, E D C B A, . . . (i.e., 100 per treatment per species). *Espacement*—2′ × 2′. *Soil preparation*—No previous burn. 9″ deep crowbar holes· *Stock used*—Stumps made from one year old plants from Chittoor nursery. *Dates of stump planting.*—31st July 1934, 31st August 1934, 30th September 1934, 11th October 1934 and 31st October 1934. *Treatment*—Kept clean weeded throughout.

Species.	Percentage of survivals in February 1935 of stumps planted on					Mean height growth in inches in February 1935 of stumps planted on				
	31st July 1934.	31st August 1934.	30th September 1934.	11th October 1934.	31st October 1934.	31st July 1934.	31st August 1934.	30th September 1934.	11th October 1934.	31st October 1934.
Acacia ferruginea	..	..	2	2	..	..	..	3·5	5·0	..
Acacia leucophlœa	..	..	..	..	..	..	..	..	..	..
Acacia sundra	..	..	..	..	..	..	..	..	..	..
Albizzia amara	..	..	16	..	..	..	..	1·5	..	..
Cassia siamea	..	..	13	59	..	..	..	1·7	3·1	..
Dolichandrone crispa	..	..	17	45	..	..	..	1·9	2·1	..
Feronia elephantum	..	..	..	9	1	..	..	..	1·1	1·0
Holoptelia integrifolia	..	..	11	32	..	..	..	1·5	2·7	..
Prosopis juliflora	..	..	..	..	..	..	..	..	..	..
Soymida febrifuga	..	..	..	14	..	..	..	..	1·5	..
Tamarindus indica	..	..	..	..	..	..	..	..	..	..
Wrightia tinctoria	..	..	52	65	..	..	..	..	2·5	2·8

286. *Direct sowing in blanks in fuel forest ten years before felling —Effect of root competition (vide paragraph* 111)—

Experiment No. 10—*Emmanur Experimental Garden.—Arrangement*—In a blank 40′ diameter each half was divided into four strips and round two of these strips trenches 2′ deep were dug. Each treatment was six lines of six stakes repeated twice A B B A, etc., i.e., 72 patches per treatment per species. *Espacement*—2′ × 2′. *Soil preparation*—No burn, soil worked 9″ × 9″ × 6″. *Stock used*—Ten seeds per patch. *Date of sowing*—12th September 1934. *Treatment*—Kept clean weeded throughout.

Species.	Fuel series.	Percentage survivals in February 1935.		Mean height growth in inches in February 1935.	
		Root competition.	*No* root competition.	Root competition.	*No* root competition.
Acacia ferruginea	Bennari	83	78	4·0	4·1
Acacia ferruginea	Kottamangalam	10	12	Destroyed by wild elephant before measurement.	
Acacia leucophlœa	Do.	8	6		
Albizzia amara	Do.	4	9		
Cassia siamea	Bennari	23	60	1·7	1·8
Tamarindus indica	Do.	20	20	3·1	3·1

287. *Dalbergia latifolia—Effect of leaving unweeded—(vide paragraph* 121)—

Experiment No. 68—*Topslip Experimental Garden.—Arrangement*—Six strips of eight lines of ten plants per line—centre six lines of each strip measured arranged AB AB AB. *Espacement*—3′ × 3′. *Soil preparation*—Patches 1′ diameter and 6″ deep. *Stock used*—15 broken pods per patch sown on 24th May 1934. *Treatment*—A, no weeding at all. B, kept free of weeds.

Growth data after one season.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Topslip Experimental Garden No. 68.	Weeded ..	2nd February 1935.	86	10·20 ± 0·54	Control.	
	Unweeded ..	Do.	92	10·35 ± 0·46	+ 0·15 ± 0·71	N.S.

288. *Teak plantation—Weeding practice—Tectona grandis—(vide paragraph* 125)—

Experiment No. 61—*Topslip Experimental Garden.—Arrangement*—Forty lines of ten plants per line s F S F f (s and f four lines each and S and F eight lines each) two lines between each treatment left as buffers and not measured, i.e., 140 plants of each treatment of which 100 only are measured. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes. *Stock used*—One year stumps 0·4″–0·7″ diameter. *Date of stump planting*—27th April 1934. *Treatment*—s S mamooty scraping in lines 4′ wide (leaving a 2′ strip of weeds). f and F forking 4′ wide and 4″ deep (leaving a 2′ strip of weeds). Both treatments applied in July, September and November.

Experiment No. 57—*Dhoni Experimental Garden.—Arrangement, etc.,*—As above but stumps 0·4″–0·07″ diameter planted on 20th April 1934.

Experiment No. 49—*Dhoni Experimental Garden—Arrangement, etc.,* As above but stumps 0·4″–0·7″ diameter planted on 20th April 1934.

Data after one season's growth.

Experiment.	Treatment.	Date of measurement.	Survival per cent.	Mean height in inches.	Difference from control.	Significance.
Topslip Experimental Garden No. 61.	Forked ..	20th January 1935.	93	41·70 ± 1·68	— 9·64 ± 2·52	S.
	Scraped ..	Do.	97	51·34 ± 1·88	Control.	
Dhoni Experimental Garden No. 57.	Forked ..	6th February 1935.	97	18·39 ± 0·64	Control.	
	Scraped ..	Do.	97	18·18 ± 0·72	— 0·21 ±0·97	N.S.
Dhoni Experimental Garden No. 49.	Forked ..	13th January 1935.	100	12·60 ± 0·66	— 2·65 ± 1·05	S.
	Scraped ..	Do.	99	15·25 ± 0·83	Control.	

289. *Effect of burning and cutting back a teak plantation in the hot weather after planting* (*vide paragraph* 133)—

Experimental plot No. 9—*Wynaad division* (*in* 1932 *teak plantation*).—*Arrangement*—Three strips 100 stakes long × six stakes wide separated by buffer strips 3 stakes wide. *Espacement*—6′ × 6′. *Initial comparability*—Established by measurements before applying treatments. *Treatments*—A control, B plants cut back no burn. C stumps burned and plants cut back immediately. *Date of burn*—17th April 1933.

Experimental Plot No. 129—*South Coimbatore division* (1932 *teak plantation*).—*Arrangement, etc.*, as above but no buffer strips. *Date of burn*—1st May 1933.

Experimental Plot No. 16—*Wynaad division* (in 1933 teak plantation) as in Experimental Plot No. 9 Wynaad above. *Date of burn*—12th April 1934.

Experimental Plot No. 136—*South Coimbatore division* (in 1933 teak plantation).—*Arrangement*—Six strips of six lines with 25 stakes per line. *Treatments*—Arranged ABC CAB. Only the middle four lines of each strip measured thus leaving buffers. *Espacement*—6′ × 6′. Initial comparability established by measurement before applying treatments. *Treatments*—as above. *Date of burn*—27th March 1934.

Experimental plot number and division.	Date of treatment.	Treatment.	Per centage of survivals.	Mean height in feet.	Difference of means.	Significance.
		February 1935 *measurements.*				
16 Wynaad ..	12th April 1934.	Control ..	98	4·11 ± 0·11	Control.	
		Cut back ..	94	3·36 ± 0·88	— 0·81 ± 0·14	S.
		Burned and cut back.	92	3·77 ± 0·90	— 0·40 ± 0·14	S.
136 South Coimbatore.	27th March 1934.	Control ..	94	6·25 ± 0·25	Control.	
		Cut back ..	89	5·90 ± 0·23	— 0·35 ± 0·34	N.S.
		Burned and cut back.	77	5·95 ± 0·26	— 0·30 ± 0·36	N.S.
		February 1934 *measurements.*				
9 Wynaad ..	17th April 1933.	Control ..	95	4·01 ± 0·12	Control.	
		Cut back ..	94	2·47 ± 0·09	— 1·54 ± 0·15	S.
		Burned and cut back.	94	2·90 ± 0·10	— 1·11 ± 0·16	S.
129 South Coimbatore.	1st May 1933.	Control ..	89	4·25 ± 0·08	Control.	
		Cut back ..	56	2·48 ± 0·13	— 1·77 ± 0·16	S.
		Burned and cut back.	60	2·69 ± 0·10	— 1·56 ± 0·12	S.

NOTE.—In all Experments initial comparability was established.

290. *Effect of soil working and of tending on growth of natural seedlings of Hopea parviflora* (*vide paragraph* 142)—

Experimental Plot No. 124—*South Coimbatore Division.*—*Arrangement*—All undergrowth cleared, all trees except *Hopea parviflora* and *Mesua ferrea* whose crowns were not in the upper canopy girdled in September 1932. Lines running across the plot 10′ apart arranged ABC CBA—with five repetitions. *Treatments*—A soil worked 3″ deep

3′ wide. B. Narrow trenches 3′ apart and 9″ deep were cut so as to sever roots met with and were then filled in. Similar trenches were cut and filled in across the 3′ strip at intervals of 4′. C. Control—no treatment. These treatments were repeated annually in January.

Experimental Plot No. 124, *South Coimbatore division—Year of formation* 1933.

Treatment.	January 1934 measurements.			
	Survival per cent.	Mean height in inches.	Difference of means.	Significance.
Soil working	85	16·55 ± 1·13	+ 1·27 ± 1·53	N.S.
Trenching	74	17·40 ± 1·42	+ 2·12 ± 1·75	N.S.
No treatment	73	15·28 ± 1·03	Control.	..

Treatment.	January 1935 measurements.			
	Survival per cent.	Mean hight in inches.	Difference of means.	Significance.
Soil working	86	25·36 ± 2·06	+ 9·63 ± 2·29	S
Trenching	71	21·20 ± 1·76	+ 5·47 ± 2·02	S
No treatment ..	90	15·73 ± 0·99	Control.	..

Initial comparability was established.

291. *Effect of burning before artificially regenerating gaps in evergreen forest* (*vide paragraph* 149)—

Experimental Plot No. 130—*South Coimbatore division—Arrangement.* Ten artificial gaps each 50′ × 50′ close together in evergreen forest were allotted to treatments ABBA. *Treatment*—In the A gaps leaf litter and small wood was piled and burned on 25th April 1933. The burn was fairly good. *Regeneration*—All gaps were regenerated alike with three species *Acrocarpus fraxinifolius* stumps on the periphery, *Artocarpus hirsuta* stumps and transplants and *Swietenia macrophylla* transplants in lines across the gaps AB BA AB BA the number of plants of each being 36, 32, 32 for the species in the order mentioned in each gap. *Espacement*—3′ × 3′. *Soil preparation*—Crowbar holes for stumps. One foot cube pits for transplants. *Date of planting*—1st July 1933. *Tending*—Patch weeding for each plant in 2′ diameter circles. *Height of surrounding forest*—About 100′.

DISTRICT—SOUTH COIMBATORE.

Species.	Experiment plot number.	Year of formation.	Treatment.	February 1934 measurement.			
				Survival per cent.	Mean height in feet.	Difference of means.	Significance.
Acrocarpus fraxinifolius.	130	1933	Burn ..	32·7	0·57 ± 0·03	+ 0·10 ± 0·04	S
			No burn.	25·0	0·47 ± 0·03	Control.	..
Artocarpus hirsuta.	130	1933	Burn ..	38·1	0·24 ± 0·01	+ 0·02 ± 0·02	N.S.
			No burn.	34·1	0·22 ± 0·01	Control.	..
Swietenia macrophylla.	130	1933	Burn ..	75·5	0·73 ± 0·02	— 0·01 ± 0·05	S
			No burn.	84·3	0·74 ± 0·02	Control.	..
Acrocarpus fraxinifolius.	130	1933	Burn ..	24·0	1·17 ± 0·09	+0·17 ± 0·13	N.S.
			No burn.	16·1	1·00 ± 0·09	Control.	..
Artocarpus hirsuta.	130	1933	Burn ..	36·2	0·35 ± 0·02	+ 0·04 ± 0·03	N.S.
			No burn.	27·5	0·31 ± 0·01	Control.	..
Swietenia macrophylla.	130	1933	Burn ..	69·3	1·38 ± 0·05	+ 0·14 ± 0·05	S
			No burn.	76·2	1·24 ± 0·03	Control	..

292. *Direct sowing—Best date—(under top canopy only)* (*vide paragraph* 155)—

Experiment No. 51—*Chandanathode Experimental Garden—Species—Cedrela toona.—Arrangement*—30 lines of ten plants arranged ABC ABC (100 plants of each date). *Espacement*—3′ × 1½′. *Soil preparation*—Patches 1′ diameter worked 6″ deep. *Seed used—local*—Five seeds per patch. *Dates of sowing*—31st July 1934, 14th August 1934 and 16th September 1934. *Treatment*—Kept clean weeded.

Experiment No. 54—*Chandanathode Experimental Garden—Species—Dysoxylum malabaricum.—Arrangement*, etc.—As above. *Seed used*—Kannoth (Wynaad). *Dates of sowing*—2nd August 1934, 16th August 1934 and 30th August 1934.

Experiment No. 29—*Karianshola Experimental Garden—Species—Cedrela toona.—Arrangement*—20 lines of ten plants arranged AB BA (i.e., 100 plants of each date). *Espacement*—3′ × 1½′. *Soil preparation*—Patches 1′ diameter worked 4″ deep. *Seed used*—From Tinnevelly district—five seeds per patch. *Dates of sowing*—15th August 1934, 1st September 1934. *Treatment*—Kept clean weeded.

Species.	Experimental garden.	Experiment number.	Year of formation.	Percentage of survivals in May 1935 of seed sown on 31st July 1934.	1st August 1934.	15th August 1934.	31st August 1934.	16th September 1934.
Cedrela toona ..	Chandanathode.	51	1934	9	..	8	..	3 *
Cedrela toona ..	Karian shola ..	29	1934	..	..	74	98	.. †
Dysoxylum malabaricum.	Chandanathode.	54	1934	..	16	1	8	.. ‡

* No significant difference in height growth.

† Difference in height growth 0·46 ± 0·13 significantly in favour of 15th August 1934 sowing.

‡ No significant difference in height growth.

293. *Entire transplanting throughout the year—Best date*—(*vide paragraph* 156)—

Experiment No. 15—*Karianshola Experimental Garden—Species—Calophyllum elatum.—Arrangement*—1 to 12, 1 to 12 repeated five times in single lines of 10 plants each, i.e., 50 plants per date. *Espacement*—2′ × 2′. *Soil preparation*—1′ cube pits. *Stock used*—Natural forest seedlings 4″ — 7″ high. *Dates of transplanting*—20th of each month from April 1933 to March 1934. *Treatment*—Kept clean weeded.

Experiment No. 13—*Karianshola Experimental Garden—Species—Hopea parviflora.—Arrangement, etc.*—As above. *Stock used*—Natural forest seedlings 4″ — 6″ high.

Experiment No. 14—*Karian shola Experimental Garden—Species—Mesua ferrea.—Arrangement, etc.*—As above. *Stock used*—Natural forest seedlings 5″ — 10″ high.

Experiment No. 27—*Chandanathode Experimental Garden—Species—Artocarpus hirsuta.—Arrangement*—Lines of 10 plants repeated five times ABCDEF ABCDEF (i.e., 50 plants of each date). *Espacement*—$3' \times 1\frac{1}{2}'$. *Soil preparation*—1′ cube pits. *Stock used*—1 year transplants 10″—12″ high. *Dates of transplanting*—20th of each alternate month from April 1933 to February 1934.

Experiment No. 28—*Chandanathode Experimental Garden—Species—Gluta travancorica.—Arrangement, etc.*—As above. *Stock used*—One year transplants 15″ — 20″ high.

Experiment No. 29—*Chandanathode Experimental Garden—Species—Hopea parviflora.—Arrangement, etc.*—As above. *Stock used*—One year transplants 12″ high.

Experiment No. 31—*Chandanathode Experimental Garden—Species—Mesua ferrea.—Arrangement, etc.*—As above. *Stock used*—Natural forest seedlings 11″—12″ high.

Species and experimental Garden.	Experiment Number.	Year of formation.	Percentage of survivals at the end of 1934 of plants transplanted on				
			20th April 1933.	20th May 1933.	20th June 1933.	20th July 1933.	20th August 1933.
1 *Artocarpus hirsuta* (Chandanathode).	27	1933	..	..	78	..	86
2 *Calophyllum elatum* (Karianshola).	15	1933	..	8	20	6	12
3 *Gluta travancorica* (Chandanathode).	28	1933	..	..	62	..	62
4 *Hopea parviflora* (Karianshola).	13	1933	12	20	42	70	52
5 *Hopea parviflora* (Chandanathode).	29	1933	74	..	74	..	98
6 *Mesua ferrea* (Karianshola).	14	1933	34	38	36	34	42
7 *Mesua ferrea* (Chandanathode).	31	1933	54	..	90	..	90

Species and experimental Garden.	Percentage of survivals at the end of 1934 of plans transplanted on						
	20th September 1933.	20th October 1933.	20th November 1933.	20th December 1933.	20th January 1934.	20th February 1934.	20th March 1934.
1 *Artocarpus hirsuta* (Chandanathode).	..	58	..	18	..	..	..
2 *Calophyllum elatum* (Karianshola).	2	4	..	..	..	..	..
3 *Gluta travancorica* (Chandanathode).	..	8	..	..	..	..	..
4 *Hopea parviflora* (Karisanshola).	26	8	..	..	..	..	14
5 *Hopea parviflora* (Chandanathode).	..	78	..	10	..	14	..
6 *Mesua ferrea* (Karianshola).	32	16	4	4	..	..	..
7 *Mesua ferrea* (Chandanathode).	..	52	..	9	..	7	..

294. *Entire transplanting—Monsoon best date (vide paragraph 158)—(Under top canopy only)*—

Experiment No. 25—*Karianshola Experimental Garden—Species—Hopea parviflora.—Arrangement* — ABCDE EDCBA repeated 10 times in single lines of 10 plants (i.e., 100 plants of each date). *Espacement*—3′ × 1½′. *Soil preparation*—Crowbar holes. *Stock used*—One year transplants 9″ — 10″ high. *Dates of transplanting*—1st August 1934, 10th August 1934, 23rd August 1934, 8th September 1934 and 22nd September 1934. *Treatment*—Kept clean weeded.

Experiment No. 27—*Karianshola Experimental Garden—Species—Swietenia macrophylla.—Arrangement, etc.*—As above. *Stock used*—Eighteen months transplants 23″ — 25″ high.

Experiment No. 30—*Karianshola Experimental Garden—Species—Dipterocarpus bourdillonii.—Arrangement, etc.*—As above. *Stock used*—Two months transplants 3″—4″ high.

Experiment No. 52—*Chandanathode Experimental Garden—Species—Hopea parviflora.—Arrangement*—50 lines of 10 plants arranged ABCDE ABCDE (i.e., 100 plants of each date). *Espacement*—3′ × 1½′. *Soil preparation*—1′ cube pits. *Stock used*—One year transplants 6″—9″ high. *Dates of transplanting*—1st August 1934, 16th August 1934, 1st September 1934, 15th September and 30th September 1934. *Treatment*—Kept clean weeded.

Experiment No. 55—*Chandanathode Experimental Garden—Species—Dysoxylum malabaricum.—Arrangement, etc.*—As above. *Stock used*—One year transplants 7″—14″ high.

Experiment No. 56—*Chandanathode Experimental Garden—Species—Gluta travancorica.—Arrangement, etc.*—As above. *Stock used*—One year transplants 10″ — 12″ high.

Experiment No. 57—*Chandanathode Experimental Garden—Species—Cedrela toona.—Arrangement, etc.*, as above. *Stock used*—One year transplants 13″—14″ high.

Experiment No. 58—*Chandanthode Experimental Garden—Species—Swietenia macrophylla.—Arrangement, etc.—As* above. *Stock used*—Seven months transplants 8″—12″ high.

Experiment No. 62—*Chandanathode Experimental Garden—Species—Hardwickia pinnata.—Arrangement, etc.*—As above. *Stock used*—Eighteen months transplants 5″—9″ high. *Dates of transplanting*—1st September 1934, 15th September 1934, 30th September 1934.

Species.	Experimental Garden.	Experiment number.	Year of formation.	Percentage of survivals in May 1935 of plants transplanted on	
				1st August 1934.	10th August 1934.
Cedrela toona	Chandanathode ..	57	1934	88	..
Dipterocarpus bourdillonii ..	Karian shola	30	1934	..	..
Dysoxylum malabaricum ..	Chandanathode ..	55	1934	29	..
Gluta travancorica	Do. ..	56	1934	40	..
Hardwickia pinnata	Do. ..	62	1934	..	..
Hopea parviflora	Do. ..	52	1934	82	..
Do.	Karian shola ..	25	1934	80	37
Swietenia macrophylla ..	Do. ..	27	1934	69	37
Do. ..	Chandanathode ..	58	1934	37	..

Species.	Percentage of survivals in May 1935 of plants transplanted on—*cont.*						
	16th August 1934.	23rd August 1934.	1st September 1934.	8th September 1934.	15th September 1934.	22nd September 1934.	30th September 1934.
Cedrela toona	79	..	86	..	90	..	96
Dipterocarpus bourdillonii ..	4	..	1	..	..	..	..
Dysoxylum malabaricum ..	2	..	35	..	31	..	..
Gluta travancorica	14	..	18	..	12	..	..
Hardwickia pinnata ..	..	..	66	..	33	..	36
Hopea parviflora	85	..	86	..	88	..	92
Do.	..	29	..	20	..	5	..
Swietenia macrophylla ..	..	1	..	1	..	..	..
Do. ..	64	..	95	..	96	..	88

REMARKS.—Differences in mean height growth are small generally being just significantly better for earlier transplantings compared with the later transplantings.

295. *Stump planting—Throughout the year—Best date (vide paragraph* 159)—

Experiment No. 25—*Chandanathode Experimental Garden—Species—Artocarpus hirsuta.—Arrangement*—Lines of 10 plants repeated 5 times arranged ABCDEF FEDCBA. *Espacement*—$3' \times 1\frac{1}{2}'$. *Soil preparation*—Crowbar holes. *Stock used*—10—20 months transplanting giving stumps from 0·3″—0·7″ diameter at the thickest part.

(*Species—Artocarpus hirsuta.*)

Species and Experimental Garden.	Experiment number.	Year of formation.	Percentage of survivals in May 1935 of stumps planted on					
			28th April 1933.	27th June 1933.	31st August 1933.	26th October 1933.	27th December 1933.	28th February 1934.
Artocarpus hirsuta Chandanathode.	25	1933	50	28	52	68	64	18

REMARKS.—Mean height growth for stumps planted on 31st August 1933, 26th October 1933, 27th December 1933, best in that order and all significantly better than 27th June 1933 used as control. The other 2 dates gave significantly poorer height growth.

296. *Stump planting—Best date—(Under top canopy only) (vide paragraph* 159)—

Experiment No. 59—*Chandanathode Experimental Garden—Species—Cedrela toona.—Arrangement*—40 lines of 10 plants arranged ABCD ABCD (i.e., 100 of each date). *Espacement*

—3′ × 1½′. *Soil preparation*—Crowbar holes. *Stock used*—One year seedlings. *Average diameter of stumps* :—0·2″ *Dates of stump planting*—13th August 1934, 29th August 1934, 14th September 1934, 30th September 1934. *Treatment*—Kept clean weeded.

Experiment No. 28—*Karianshola Experimental Garden*—*Species* — *Artocarpus hirsuta*.—*Arrangement* — ABCDE ED CBA in single lines of 10 plants repeated 10 times (i.e., 100 of each treatment). *Espacement and soil preparation*—As above. *Stock used*—Fifteen months transplants giving stumps 0·2″—0·3″ diameter. *Dates of stump planting*—At intervals of a fortnight from 27th July 1934. *Treatment*—Kept clean weeded.

Species.	Experimental Garden.	Experiment number.	Year of formation.	Percentage of survivals in May 1935 of stumps planted on 27th July 1934.	13th August 1934.	24th August 1934.
Cedrela toona ..	Chandanathode.	59	1934	..	11	..
Artocarpus hirsuta ..	Karianshola ..	28	1934	47	63	87

Species.	Percentage of survivals in May 1935 of stumps planted on 29th August 1934.	7th September 1934.	14th September 1934.	21st September 1934.	30th September 1934.	
Cedrela toona ..	37	..	58	..	52	Stumps planted on 14th September 1934 gave significantly the best mean height growth being 30 per cent better than those planted on any other date.
Artocarpus hirsuta.	..	68	..	86	..	Stumps planted on the last 3 dates gave significantly poorer height growth when compared with those planted on the first two dates.

297. *Stump planting—Best size of stumps*—(*Top canopy only*) (*vide paragraph* 161)—

Experiment No. 31—*Karianshola Experimental Garden*—*Species* — *Artocarpus hirsuta*.—*Arrangement* — B.S.S.B. repeated 10 times in single lines of 10 plants (i.e., 100 of each treatment). *Espacement*—3′ × 1½′. *Soil preparation*—Crowbar holes. *Stock used*—Fifteen months nursery seedlings. *B. Stumps*—0·4″—0·5″ diameter at the thickest part. *S. Stumps*—0·1″—0·2″ diameter at the thickest part. *Date of stump planting*—17th August 1934. *Treatment*—Kept clean weeded.

Species.	Experimental Garden.	Experiment number.	Year of formation.	Percentage of survivals in February 1935. Big stumps.	Small stumps.
Artocarpus hirsuta ..	Karianshola ..	31	1934	82	42

Species.	Mean height growth in February 1935. Big stumps.	Small stumps.	Difference of means in favour of big stumps.	Significance.
Artocarpus hirsuta ..	2·38 ± 0·99	1·52 ± 0·97	+ 0·86 ± 0·14	Significant.

298. *Comparison of direct sowing, entire transplanting, large and small transplants, stumping large and small stumps*—(*Under top canopy only*) (*vide paragraph No.* 162)—

Experiment No. 36—*Karianshola—Experimental Garden—Species—Artocarpus hirsuta.—Arrangement*—S P P S, etc., repeated 10 times in single lines of 10 plants. *Espacement*—$3' \times 1\frac{1}{2}'$. *Soil preparation*—Crowbar holes. *Stock used*—Transplants and stumps from nursery plants 15 months old and $3\frac{1}{2}''$ high. *Stumps*—0·2″ to 0·6″ diameter. *Date of sowing and stumping*—20th August 1934. *Treatment*—Kept clean weeded.

Experiment No. 46—*Chandanathode Experimental Garden—Species—Artocarpus hirsuta.—Arrangement*—Fifty lines of 10 stakes arranged ABCDE EDCBA (i.e., 100 plants of each treatment). *Espacement*—$3' \times 1\frac{1}{2}'$. *Soil preparation*—A patches 1′ diameter worked to 6″ depth, B and C 1′ cube pits. D and E crowbar holes. *Stock used*—A sowing local 1934 crop 9 seeds per patch. B and C 1 year transplants. B 6″ high, C 12″ high. D and E stumps made from 1 year transplants D 0·22″ diameter E stumps 0·12″ diameter. *Date of sowing*—A. 12th June 1934. *Date of transplanting and stumping*—BCDE. 20th August 1934. *Treatment*—Kept clean weeded.

Experiment No. 49—*Chandanathode Experimental Garden—Species—Cedrela toona.—Arrangement*—Forty lines of 10 plants arranged ABCD DCBA (i.e., 100 plants of each treatment). *Espacement*—$3' \times 1\frac{1}{2}'$. *Soil preparation*—A patches 1′ diameter and worked 6″ deep. B and C 1′ cube pits. D crowbar holes. *Stock used*—A local seed 1934 crop 15 seeds per patch. B and C 1 year transplants B 7″ high, C 11″ high. D 1 year transplants made into stumps 0·5″ diameter. *Date of sowing*—12th June 1934. *Date of transplanting and stumping*—1st August 1934. *Treatment*—Kept free of weeds.

Experiment No. 53—*Chandanathode Experimental Garden—Species—Dysoxylum malabaricum.—Arrangement*—Twenty lines of 10 plants arranged ABBA (i.e., 100 plants of each treatment). *Espacement*—$3' \times 1\frac{1}{2}'$. *Soil preparation*—

A patches 1′ diameter worked 6″ deep, B 1′ cube pits. *Stock used*—A local seed 1934 crop 2 seeds per patch. B 1 year transplants. *Date of sowing*—A 29th July 1934. *Date of transplanting*—16th August 1934. *Treatment*—Kept free of weeds.

Experiment No. 40—*Chandanathode Experimental Garden—Species—Gluta travancorica.—Arrangement and espacement*—As above. *Soil preparation*—1′ cube pits. *Stock used*—1 year transplants A 18″ to 20″ high B 12″ to 14″ high. *Date of transplanting*—29th August 1933. *Treatment*—Kept free of weeds.

Experiment No. 61—*Chandanathode Experimental Garden—Species—Gluta travancorica.—Arrangement, etc.*—As above. *Soil preparation*—1′ cube pits. *Stock used*—One year transplants A 2′ 9″, B 1′ 5″ high. *Date of transplanting*—21st August 1934. *Treatment*—Kept clean weeded.

Experiment No. 48—*Chandanathode Experimental Garden—Species—Hopea parviflora.—Arrangement*—Thirty lines of 10 plants arranged ABC CBA (i.e., 100 of each treatment). *Espacement*—3′ × 1½′. *Soil preparation*—A patches 1′ diameter worked 6″ deep ; B and C 1′ cube pits. *Stock used*—A local seed 1934 crop 15 seeds per patch B and C 1 year transplants. B 6″—15″ high, C 11″—27″ high. *Date of sowing*—A 12th June 1934. *Date of transplanting*—B and C 16th August 1934. *Treatment*—Kept clean weeded.

Experimental No. 41—*Chandanathode Experimental Garden—Species—Hopea parviflora.—Arrangement*—Lines of 20 plants repeated AB BA 5 times (i.e., 100 of each treatment). *Espacement*—3′ × 1½′. *Soil preparation*—1′ cube pits. *Stock used*—1 year transplants A 15″ to 16″ high, B 8″—9″ high. *Date of transplanting*—29th August 1933. *Treatment*—Kept clean weeded.

Experiment No. 35—*Karianshola Experimental Garden—Species—Hopea parviflora.—Arrangement and espacement*—As above. *Soil preparation*—Crowbar holes. *Stock used*—15 months transplants A 8″ high, B 15″ high. *Date of transplanting*—20th August 1934. *Treatment*—Kept clean weeded.

Experiment No. 20—*Karianshola Experimental Garden—Species—Hopea parviflora.—Arrangement*—As above. *Espacement*—2′ × 2′. *Soil preparation*—1′ cube pits. *Stock used*—Fifteen months transplants A 4″ high, B 2″ high. *Date of transplanting*—18th August 1933. *Treatment*—Kept clean weeded.

Experiment No. 34—*Karianshola Experimental Garden—Species—Swietenia macrophylla.—Arrangement*—DP PD repeated 10 times in single lines of 10 plants (i.e., 100 plants of each

treatment). *Espacement*—3′ × $1\frac{1}{2}$′. *Soil preparation*—D patches 1′ diameter dug 6″ deep. P. Crowbar holes. *Stock used*—D Dhoni 1934 crop 10 seeds per patch. P. 1 year transplants $3\frac{1}{4}$″ high. *Date of sowing*—D 18th August 1934. *Date of transplanting*—18th August 1934. *Treatment*—Kept clean weeded.

Experiment No. 19—*Karianshola Experimental Garden*—*Species*—*Swietenia macrophylla.*—*Arrangement*—As above. *Espacement*—2′×2′. *Soil preparation*—1′ cube pits. *Stock used*—16 months transplants A $9\frac{1}{2}$″ high, B 5″ high. *Date of transplanting*—18th August 1933. *Treatment*—Kept clean weeded.

Experiment No. 32—*Karianshola Experimental Garden*—*Species*—*Swietenia macrophylla.*—*Arrangement*—As above. *Espacement*—3′×$1\frac{1}{2}$′. *Soil preparation*—Crowbar holes. *Stock used*—16 months transplants B. 36″ high, S 4″ high. *Date of transplanting*—17th August 1934. *Treatment*—Kept clean weeded.

Experiment 47—*Chandanathode Experimental Garden*—*Species*—*Swietenia macrophylla.*—*Arrangement*—40 lines of 10 plants per line arranged ABCD DCBA D lines left blank as stock not available. *Espacement*—3′×$1\frac{1}{2}$′. *Soil preparation*—A patches 1′ diameter worked 6″ deep, B and C 1′ cube pits. *Stock used*—A Nilambur 1933-34 crop, 10 seeds per patch, B and C 15 months transplants B $8\frac{1}{2}$″ high, C 16″ high. *Date of sowing*—A 12th June 1934. *Date of transplanting*—B and C 1st August 1934. *Treatment*—Kept clean weeded.

Experiment No. 5 *Chandanathode Experimental Garden*—*Species*—*Artocarpus hirsuta.*—*Arrangement*—AB BA in sets of 4 plants repeated 25 times, i.e., 100 of each treatment. *Espacement*—$1\frac{1}{2}$′×$1\frac{1}{2}$′. *Soil preparation*—1′ cube pits. *Stock used*—Natural forest seedlings A 9″ high, B 4″ high. *Date of transplanting*—31st August 1932. *Treatment*—Kept clean weeded.

Experiment No. 7—*Chandanathode Experimental Garden*—*Species*—*Dysoxylum malabaricum*—*Arrangement, etc.*—As above. *Stock used*—1 year nursery seedlings A 12″ high, B 7″ high. *Date of transplanting*—30th August 1932.

Experiment No. 6—*Chandanathode Experimental Garden*—*Species*—*Hopea parviflora.*—*Arrangement, etc.*—As above. *Stock used*—Natural forest seedlings, A 12″, B 7″ high. *Date of transplanting*—31st August 1932.

Experiment No. 8—*Chandanathode Experimental Garden*—*Species*—*Mesua ferrea.*—*Arrangement*—As above. *Stock used*—Natural forest seedlings, A 14″, B 6″ high.

Species.	Experimental garden.	Experi-ment number.	Year of forma-tion.	Percentage of survivals in May 1935.	
				Sowing.	Trans-plant-ing.
(1)	(2)	(3)	(4)	(5)	(6)
Artocarpus hirsuta	Karian shola ..	36	1934	..	..
Do.	Chandanathode ..	46	1934	27	..
Do.	Do. ..	5	1932	..	..
Cedrela toona	Do. ..	49	1934	..	..
Dysoxylum malabaricum ..	Do. ..	53	1934	2	31
Do.	Do. ..	7	1932	..	..
Gluta travancorica	Do. ..	40	1934	..	..
Do.	Do. ..	61	1934	..	..
Hopea parviflora	Do. ..	48	1934	1	..
Do.	Do. ..	41	1934	..	..
Do.	Do. ..	6	1932	..	..
Do.	Karian shola ..	35	1934	..	..
Do.	Do. ..	20	1933	..	..
Mesua ferrea	Chandanathode ..	8	1932	..	..
Swietenia macrophylla	Do. ..	34	1934	34	74
Do.	Do. ..	19	1933	..	..
Do.	Do. ..	32	1934	..	..
Do.	Do. ..	47	1934	..	..

Species.	Percentage of survivals in May 1935—*cont.*					Whether initial difference in height between the big and small transplants was increased (I), maintained (M) or decreased (D).
	Small trans-plants.	Large trans-plants.	Stump-ing.	Small stumps.	Large stumps.	
	(7)	(8)	(9)	(10)	(11)	(12)
Artocarpus hirsuta	..	..	62	..	..	..
Do.	40	55	..	41	74	D
Do.	59	63	..	..	..	M
Cedrela toona	54	82	55	..	..	I
Dysoxylum malabaricum ..	..	..	..	..	..	..
Do. ..	33	58	..	..	..	M
Gluta travancorica	90	83	..	..	..	M
Do.	58	8	..	..	..	D
Hopea parviflora	90	84	..	..	..	D
Do.	72	70	..	..	..	M
Do.	51	85	..	..	..	M
Do.	21	2	..	..	..	D
Do.	67	80	..	..	..	I
Mesua ferrea	86	90	..	..	..	M
Swietenia macrophylla	..	..	..	..	..	..
Do.	45	56	..	..	..	D
Do.	80	22	..	..	..	D
Do.	38	67	..	..	..	D

299. *Entire transplanting in pits compared with crowbar holes—(vide paragraph* 164)—

Chandanathode experimental garden Experiments Nos. 1, 2, 3, 4, 35, 36, 38 and 39.

Karianshola experimental garden Experiments No. 17 *and* 18.—Experimental details given in last year's Annual Report, paragraph 166.

Species.	Experi-mental garden.	Experi-ment number.	Year of forma-tion.	Percentage of survivals in May 1935 of plants planted in.		Percentage gain in heigh of plants in pits over plants in crowbar holes.
				Pits.	Crowbar holes.	
Artocarpus hirsuta.	Chandana-thode.	2	1932	51	54	14
Do.	Do.	38	1933	71	48	77
Dysoxylum mala-baricum.	Do.	3	1932	37	35	9
Gluta travancoria.	Do.	36	1933	52	28	0
Hopea parviflora ..	Do.	35	1933	85	78	3
Do. ..	Karianshola.	17	1933	62	61	36
Do. ..	Chandana-thode.	1	1932	75	68	2
Mesua ferrea ..	Do.	4	1932	91	92	28
Do. ..	Do.	39	1933	84	78	19
Swietenia macro-phylla.	*Karianshola.*	18	1933	81	91	8

300. *Entire transplanting—Comparison of nursery plants with natural forest seedlings (vide paragraph 165)—*

Experiment No. 26—*Karianshola Experimental Garden—Species—Hopea parviflora.—Arrangement*—ABBA repeated 10 times of single lines of 10 plants (i.e., 100 plants of each kind). *Espacement*—3′ × 1½′. *Soil preparation*—Crowbar holes. *Stock used*—A One year transplants 9″ high. B Natural seedlings 10″ high. *Date of transplanting*—26th July 1934. *Treatment*—Kept clean weeded.

Experiment No. 23—*Karianshola Experimental Garden—Species—Hopea parviflora.—Arrangement, etc.*—As above. *Espacement*—2′ × 2′—*Soil preparation*—Standard pits. *Stock used*—A Nursery transplants 15 months old 3″ high. B Natural forest seedlings 3″ high. *Date of transplanting*—17th August 1933. *Treatment*—Kept clean weeded.

Experiment No. 24—*Karianshola Experimental Garden—Species—Mesua ferrea.—Arrangement, etc.*—As above. *Stock used*—A 16 months transplants 3½″ high. B Natural forest seedlings 5″ high. *Date of transplanting*—18th August 1933. *Treatment*—Kept clean weeded.

Experiment No. 64—*Chandanathode Experimental Garden—Species—Mesua ferrea.—Arrangement, etc.*—As above. *Espacement*—3′ × 1½′. *Soil preparation*—1′ cube pits. *Stock used*—A 16 months nursery seedlings 8″—2′ 6″ high. B Natural forest seedlings 7″ to 2′ 6″ high. *Date of transplanting*—12th September 1934. *Treatment*—Kept clean weeded.

Experiment No. 63—*Chandanathode Experimental Garden—Species—Palaquium ellipticum.—Arrangement, etc.*—As above. *Stock used*—A 14 months nursery seedlings 7″ to 10″ high. B Natural forest seedlings 7″ to 10″ high. *Date of transplanting*—29th September 1934.

Experiment No. 34—*Chandanathode Experimental Garden—Species—Hopea parviflora.—Arrangement, etc.*—As above. *Stock used*—A One year nursery transplants 10″—13″ high. B Natural forest seedlings 10″—13″ high.

Species.	Experimental garden.	Experiment number.	Year of formation.	Percentage survivals in April 1935. Nursery seedlings.	Natural forest seedlings.	Remarks.
Hopea parviflora.	Karianshola.	26	1934	87	29	Initial differences in height growth have been maintained.
Do.	Do.	23	1933	60	59	The initial superiority in height growth of natural forest seedlings has been greatly increased.

Species.	Experimental garden.	Experiment number.	Year of formation.	Percentage survivals in April 1935.		Remarks.
				Nursury seedlings.	Natural forest seedlings.	
Hopea parviflora.	Chandanathode.	34	1933	15	43	The initial superiority in height growth of natural forest seedlings has not quite been maintained.
Mesua ferrea.	Do.	24	1933	68	56	The initial superiority in height growth of natural forest seedlings has been greatly increased.
Do.	Do.	64	1934	2	6	No difference in height growth between the treatments worth recording.
Palaquium ellipticum.	Do.	63	1934	2	16	Do.

301. *Comparison of naked root transplanting mossing and basketing (vide paragraph* 166)—

Experiment No. 60—*Chandanathode Experimental Garden—Species—Dipterocarpus bourdillonii.—Arrangement*—Thirty lines of 10 plants per line arranged ABC ABC (i.e., 100 of each treatment). *Espacement*—3′ × $1\frac{1}{2}$′. *Soil preparation*—1′ cube pits. *Stock used*—A. Germinating seeds 1 per basket. B Two months transplants 3″ high mossed 1 month before transplanting. C Two months transplants 3″ high. *Date of all treatments*—12th August 1934. *Treatment*—Kept clean weeded.

NOTE.—The basketed transplants should have been well established in the baskets before planting out. This was not correctly done.

Experiment No. 33—*Karianshola Experimental Garden—Species—Dipterocarpus bourdillonii.—Arrangement, etc.*—As above only 2 for 2 treatments. *Stock used*—A. Two months transplants 3″ high. B One month transplants were basketed on 29th July 1934; when the baskets were planted, the plants were 3·3″ high. *Date of both treatments*—17th August 1934. *Treatment*—Kept clean weeded.

Species.	Experimental garden.	Experiment number.	Year of formation.	Percentage of survivals in May 1935.			Remarks.
				Naked root transplants.	Mossed plants.	Basket plants.	
Dipterocarpus bourdillonii.	Chandanathode.	60	1934	76	70	0	No difference in height growth initially or at the end of the year. The basketed plants did not get a fair chance as they were not established in the baskets before planting.
Do.	Karianshola.	33	1934	32	..	89	Basketed plants increased their initial advantage in height growth and were almost significantly ahead.

302. *Entire transplanting—Effect of weeding (vide paragraph* 167)—

Experiment No. 43—*Chandanathode Experimental Garden—Species—Mesua ferrea.—Arrangement*—Four lines weeded, 4 lines unweeded arranged AB BA—repeated 9 times 10

plants per line (i.e., 360 plants of each treatment). *Espacement*—3′ × 3′. *Soil preparation*—1′ cube pits. *Stock used*—Natural forest seedlings 6″—7″ high. *Date of transplanting*—5th September 1933.

Experiment No. 42—*Chandanathode Experimental Garden—Species—Hopea parviflora.—Arrangement, etc.*—As above. *Stock used*—One year transplants 9″ — 12″ high. *Date of transplanting*—30th August 1933.

Experiment No. 22—*Karianshola Experimental Garden—Species—Hopea parviflora.—Arrangement, etc.*—As above, but repeated 10 times. *Stock used*—Three months transplants 3½″ high. *Date of transplanting*—19th August 1933.

Experiment No. 21—*Karianshola Experimental Garden—Species—Swietenia macrophylla.—Arrangement, etc.*—As above, but repeated 10 times. *Stock used*—Four months transplants 6″ high. *Date of transplanting*—17th August 1933.

NOTE.—In the above four experiments weeding consists of the removal of all herbaceous growth and the cutting back of all woody growth less than the height of a man.

Species.	Experimental garden.	Experiment number.	Year of formation.	Percentage of survivals in May 1935.		Percentage increase in mean height growth in weeded lines over unweeded lines.	Remarks.
				Weeded.	Unweeded.		
Mesua ferrea.	Chandanathode.	43	1933	83	78	6	Significant.
Hopea parviflora.	Do.	42	1933	89	81	4	Not significant.
Do.	Karianshola.	22	1933	66	56	10	Significant.
Swietenia macrophylla.	Do.	21	1933	62	43	3	Not significant.

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